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The Endogenous Money IS-LM Model of the Debt Money System (Part II)

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The Endogenous Money IS-LM Model of the Debt Money System (Part II)
– Loanable Funds vs. Endogenous Money –

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Abstract

In Part II we expand the endogenous money IS-LM model presented in Part I into more comprehensive models by incorporating budget equations based on the Accounting System Dynamics (ASD) approach. The first model is called *Loanable Funds IS-LM* in which money stock is exogenously supplied by the central bank, and banks play a role as intermediaries of existing funds as savings. The second model is called *Endogenous Money IS-LM* in which a central bank issues base money and private banks finance loans by creating new deposits when government, households and producers borrow money. Our simulations confirm the first model failed to support the Keynesian view that aggregate demand creates its supply. The second model, on the other hand, is shown to support the view that aggregate demand creates its supply. The endogenous money IS-LM model successfully reproduces dynamics of the Great Depression as obtained by Part I model, as well as the case of Japan's lost 30 years, which was previously unexplained. As a result of the structural expansion, the second model also produces the money-debt relationship as well as its decomposition observed in the U.S. and Japan where government debts approximate M_1, and total debts held by non-banking private sectors approximate time deposits, respectively. At this stage of research we are convinced that the Keynesian theory grounded on exogenous money is no longer valid under the current *debt money system*. It is applicable and effective only under the *public money system* where money stock is controlled by the monetary authority. The endogenous money must be at the center of macroeconomics. All textbooks that apply standard IS-LM analysis must be rewritten accordingly. The ASD model presented in Part II provides the framework for theoretical and applied case studies.

Keywords: endogenous money, loanable funds, IS-LM analysis, ex ante and ex post incomes, fractional reserve banking, accounting system dynamics, Japan's lost 30 years

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Introduction

This is Part II of our paper series entitled: *The Endogenous Money IS-LM Model of the Debt Money System*. We have shown in Part I (Yamaguchi and Yamaguchi, 2022) that the standard short-run IS-LM model, which is arguably the most popular model that appear in standard macroeconomics textbooks including Mankiw (2016), failed to explain the behaviors of the Great Depression due to its flawed assumptions that money is exogenously given and that price level is fixed. As discussed in Part I, the exogenous money assumption is an obvious and fatal flaw as a macroeconomic model since it is both empirically and theoretically unfounded (Yamaguchi, 2021b; Yamaguchi and Yamaguchi, 2021a). To address this, we constructed a system dynamics (SD) model of the IS-LM analysis in Part I and found that the extended model, with flexible price and endogenous money newly incorporated, captures the unexplained behaviors of key macroeconomic variables observed in the United States during the Depression. Specifically we proposed the alternative *endogenous money spending hypothesis* where it was assumed that decline in spending (aggregate demand) and contractions in money stock occurred simultaneously. The structural and behavioral assumptions employed in the revised IS-LM model was that money is created endogenously against debts (bank loans) along with economic activities; that is, money stock M^s is a function of transactions T in terms of the quantity equation proposed by Fisher (1920). For this purpose, we took a simple mechanistic approach where money stock is created or destroyed proportionately according to the growth rate of income, and called this alternative model the endogenous money IS-LM model in Part I.

The model worked well, as expected, in that it is able to explain the Great Depression, and seemed to provide a general theory of economic recessions. Yet, we have also identified its limitations. Specifically the model cannot produce the case of the decades-long stagnation of the Japanese economy since the burst of financial bubble in the mid 1990s. The Japan' s prolonged recession, often called *the lost 30 years*, is characterized by the stagnation of aggregate demand and ineffectiveness of monetary and fiscal policies, which, according to the conventional IS-LM analysis, would have brought the economy back into a new (comparative static) equilibrium point with a higher level of income either by fiscal or monetary policy alone, or through the combination of the two as the policy mix. The series of aggressive deficit spendings by the government and unconventional monetary policy known as the Quantitative Easing (QE) implemented by the Bank of Japan, however, have been largely ineffective contrary to what the standard IS-LM model would have predicted. As a result of the policy failures, the total money stock of Japan M_3 continues to expand while the economic growth remains stagnant. The government debt is increasing at an exponential rate and the economy is now facing government debt crisis. The revised IS-LM model in Part I failed to capture this peculiar case of policy resistance observed in Japan, which we described as "the point J" in the Figure 18 of Part I paper. These observations suggest the endogenous money IS-LM model developed in Part I has to be further revised so that it can capture borrowing and lending of money among domestic macroeconomic sectors; that is, incorporating budget equations instead of the simple mechanistic approach employed in Part I. This is the main purpose of Part II.

1 The Flexible Price IS-LM Model Revisited

To make our description of modeling complete, let us start by briefly revisit the endogenous money IS-LM model with flexible price presented in Part I. The Keynesian short-run IS-LM

model under flexible price assumptions is described as follows:

$$
\begin{aligned}
Y &= AD && \text{(Aggregate Demand Equilibrium)} && (1)\\
AD &= C + I + G && \text{(Aggregate Demand)} && (2)\\
C &= C_0 + cY_d && \text{(Consumption Decisions)} && (3)\\
Y_d &= Y - T && \text{(Disposable Income)} && (4)\\
T &= T_0 + tY - T_r && \text{(Tax Revenues)} && (5)\\
I &= \frac{I_0}{r} - \alpha r && \text{(Investment Decisions)} && (6)\\
G &= \bar{G} && \text{(Government Expenditures)} && (7)\\
\frac{M^s}{P}V &= L^d && \text{(Equilibrium of Money)} && (8)\\
L^d &= aY - bi && \text{(Demand for Money)} && (9)\\
r &= i - \pi^e && \text{(Fisher Equation)} && (10)
\end{aligned}
$$

The model consists of 10 equations with 10 unknowns;

$$Y, AD, C, I, G, Y_d, T, r, i, L^d$$

with 14 exogenously determined parameters;

$$C_0, c, T_0, t, T_r, I_0, \bar{G}, M^s, P, V, \alpha, a, b, \pi^e.$$

L^d stands for liquidity demand based on the liquidity preference theory, and π^e denotes expected inflation rate. In this IS-LM model, all variables are expressed with real units except money stock M^s which has nominal unit. Investment is here assumed to be determined by (*ex ante*) real interest rate r in equation (6), while demand for money is determined by nominal interest rate i in equation (9). Real interest rate r is determined by the expected inflation rate π^e in the Fisher equation (10). Capital accumulation ($\frac{dK}{dt}$) is excluded from this IS-LM model so that capital depreciation (δK) is also deleted from the equation (4).[1]

2 Loanable Funds IS-LM Model

The Keynesian flexible price IS-LM model presented above is not complete in the sense that it lacks the analysis of budget equations, the borrowing and lending of money, and debts. As a result, in our extended IS-LM model in Part I, endogenous money is incorporated in a mechanistic way along with the growth rate of income. Consequently, the model is shown to have a limitation as pointed out above. For instance, it failed to present endogenous money creation by the government spending and accumulation of debts as its consequence.

[1] When capital accumulation is considered, which will be incorporated in our next paper (Part III) of this series, this Keynesian model needs to be revised as follows (where δ denotes a depreciation rate):

$$
\begin{aligned}
Y_d &= Y - T - \delta K\\
\frac{dK}{dt} &= I - \delta K
\end{aligned}
$$

With these analytical limitations in mind, we now start with the construction of a complete IS-LM model with budget equations. Yet, at this stage of the current paper, we hold the mainstream Keynesian assumption again that money is exogenously given, and that banks only play a role as pure financial intermediaries of existing funds between savers and borrowers. That is to say, savings (time deposits) are considered as the source of loanable funds for banks to make loans. Let us call this model *Loanable Funds IS-LM model*, and examine its workings analytically in this section first. Then, we will construct the *Endogenous Money IS-LM model* by applying the Accounting System Dynamics (ASD) method in the next section.[2]

Budget Equation of Households

Let us begin with the budget equation of households. Their income consists of distributed incomes of wages and profits (as dividends) $(W + \Pi)$ paid by producers, in nominal unit, and borrowings from banks (ΔD_H) for housing investments. With these income revenues, households spend on consumption, pay taxes to the government, and purchase houses (I_H). The remaining income after these expenditures are saved with banks as savings (S). Hence, their budget equation becomes as follows:

$$PC + PT + PI_H + S = W + \Pi + \Delta D_H \quad \text{(Households Budget)} \tag{11}$$

$$W + \Pi = PY \quad \text{(Distributed Income)} \tag{12}$$

$$PI_H = \Delta D_H \quad \text{(Housing Budgets)} \tag{13}$$

$$I_H = \bar{I}_H \quad \text{(Housing Investment)} \tag{14}$$

where housing investment is assumed to be made by the given amount of $\bar{I}_H$ for simplicity, and paid with the borrowings from banks.

Budget Equation of Producers

Producers' income comes from the sales of outputs (Y), which is assumed to be fully distributed among workers as wages (W) and their owners (shareholders) as profits (dividends) (Π). In other words, producers retain no earnings. Accordingly they are obliged to raise funds to make new investment (I_P). For simplicity we assume that they borrow all of the funds for their investment from banks (ΔD_P). Hence, their budget equation becomes as follows:

$$W + \Pi + PI_P = PY + \Delta D_P \quad \text{(Producers Budget)} \tag{15}$$

$$I_H + I_P = I \quad \text{(Total Private Investment)} \tag{16}$$

where total investment in the economy consists of housing investment and corporate investment made by producers.

Budget Equation of the Government

Government's revenues consist of taxes (T) and borrowings by issuing bonds (ΔD_G) in case government expenditures (G) exceeds tax revenues. For simplicity, we assume that government borrows directly from banks, instead of issuing and selling bonds to the banks. Hence, the budget equation of the government becomes as follows:

[2] In this sense Part II is following the same analytical steps as employed in Part I; that is, building exogenous and endogenous money IS-LM models (with budget equations in Part II) and compare the workings of the two models. Part I examined four cases in total: fixed price & exogenous money (case 1), flexible price & exogenous money (case 2), fixed price & endogenous money (case 3), and flexible price & endogenous money (case 4).

$$PG \quad = \quad PT + \Delta D_G \qquad \text{(Government Budget)} \tag{17}$$

Budget Equation of Banks

Banks accept savings deposits from households, and make loans (called loanable funds ΔLF) out of the savings deposits received from households. In this sense, banks here are assumed to merely act as a *pure* financial intermediaries as the mainstream economics often assumes. Hence, their budget equation becomes as follows:

$$\Delta LF \quad = \quad S \qquad \text{(Banks Budget)} \tag{18}$$

A Complete Loanable Funds IS-LM Model

Now the construction of loanable funds IS-LM model with budget equations is complete. In addition to the flexible price IS-LM model consisting of 10 equations (1) through (10), 8 equations (11) through (18) have now been added. Accordingly, 8 additional unknown variables that correspond to these 8 equations are identified as follows:

$$S, I_H, W + \Pi, I_P, \Delta D_H, \Delta D_P, \Delta D_G, \Delta LF \ ^{3}$$

with one additional exogenous parameter: $\bar{I}_H$

More comprehensively, Keynesian loanable funds IS-LM model presented here consists of 18 equations in total; (1) through (10) and (11) through (18), with 18 unknown variables and 15 parameters (consisting of the previous 14 parameters and the additional parameter $\bar{I}_H$). Money stock M^s is here assumed to be exogenously determined and price level is fixed by default as well. Hence, the loanable funds IS-LM model does not change the analytical framework of the flexible price IS-LM model presented in Part I by itself.

Loanable Funds Equilibrium

To examine the workings of this IS-LM model, let us now obtain the so-called Walras Law, which is calculated from the budget equations (11) through (18) as follows:

$$P(C + I + G - Y) + \Delta LF - (\Delta D_H + \Delta D_P + \Delta D_G) \equiv 0 \quad \text{(Walras Law)} \tag{19}$$

This Walras law holds true under any situations, and that is why it is presented as identity ($\equiv$). Since the Keynesian aggregate demand equilibrium of real economic sector is assumed as the equation (1), the equilibrium of the following *loanable funds* is simultaneously attained:

$$\Delta D_H + \Delta D_P + \Delta D_G = \Delta LF \qquad \text{(Loanable Funds Equilibrium)} \tag{20}$$

This indicates that banks must make loans to households, producers and the government out of their loanable funds deposited or 'saved' by the households. Since the total amount of money M^s is given by the central bank as a exogenous parameter under the loanable funds IS-LM model, banks' lending behavior is always constrained by the available amount of the loanable funds. In other words, banks are simply financial intermediaries to transfer excess funds from depositors (households) to borrowers. There is no extra room for deposit creation under this

[3] Distributed income of wages and profits ($W + \Pi$) is to be determined by producers' output (PY) and treated as an unknown variable.

loanable funds model. This has been the doctrine of exogenous money that has dominated the Keynesian macroeconomics for over 80 years as discussed in Part I.

From the Walras law, if the equilibrium of the loanable funds (20) is assumed first, the aggregate demand equilibrium in equation (1) is also simultaneously attained. Which assumption of the equilibrium should be made as the appropriate model of loanable funds IS-M, then? Aggregate demand equilibrium or loanable funds equilibrium?

Since households, producers and government cannot start their economic activities without enough funds at hand, their borrowings have to come first. This means that the equation of the loanable funds by banks (20) must be met first. Then, the aggregate demand equilibrium is simultaneously attained to be equal to GDP. In this way, from the macroeconomic point of view, it would be more appropriate to assume the loanable funds equilibrium in the IS-LM model first such that

$$(\Delta D_H + \Delta D_P + \Delta D_G = \Delta LF) \Longrightarrow (C + I + G = Y) \tag{21}$$

Hence, the loanable funds IS-LM must be formally presented by replacing the aggregate demand equilibrium (1) in the Keynesian short-run IS-LM model with the loanable funds equilibrium (20). That is, the loanable funds IS-LM model now consists of 18 equations, from (2) through (10), (11) through (18) and (20), with the same 18 unknowns and 15 parameters.

Savings in the loanable funds IS-LM model are fully utilized as follows:

$$S \Rightarrow \Delta LF \Rightarrow PI_H + PI_P + \Delta D_G = PI + \Delta D_G \tag{22}$$

That is, savings made by households become the sources of investment by households and producers, and government debts.

Model Anatomy with *Ex Ante* and *Ex Post* Incomes

At its analytical framework, the loanable funds IS-LM model developed here is the same as the Keynesian IS-LM model presented in Part I. We have already shown in Part I that the conventional IS-LM model, even under the flexible price assumption (which we called the extended analysis in part I), failed to explain economic behaviors such as the Great Depression and Japan's lost 30 years, and discussed the reason why. The standard IS-LM analysis incorrectly assumed the exogenous money under the current debt money system. Can we similarly argue that the loanable funds IS-LM model is flawed, then?

Let us examine the validity of the model by introducing the concepts of *ex ante* and *ex post* discussed by Keen (2014). The term *ex ante* is used here as a previous period in which income is distributed as wages and profits such as last month, last quarter or last year, while *ex post* as its next period such as this month, this quarter or this year.[4] Keynesian theory asserts that *ex post* aggregate demand determines *ex post* income. Yet, the loanable funds IS-LM model leads us to the opposite result; that is, *ex ante* income determines *ex post* aggregate demand.

To examine this reasoning, let us now interpret aggregate demand $AD = I + C + G$ as *ex post* demand, and income Y as *ex ante* income $\underline{Y}$ in the model. This makes sense because *ex ante* income realized by producers is assumed to be distributed as wages and profits. For the economy to grow, then, we need to assume that

$$C + I + G > \underline{Y} \qquad (Ex\ post\ AD\ >\ Ex\ ante\ \underline{Y}) \tag{23}$$

[4]To avoid confusion, it should be noted here that the terms *ex ante* and *ex post* here are used in a different way as we did in Part I to distinguish the *ex ante* and *ex post* real interest rates.

From the Walras law (19), we have

$$C + I + G > \underline{\mathrm{Y}} \iff \Delta\underline{\mathrm{LF}} < \Delta D_H + \Delta D_P + \Delta D_G \tag{24}$$

where $\Delta\underline{\mathrm{LF}}$ implies *ex ante* loanable funds saved by households as deposits with banks. This is because loanable funds of banks are constrained by the *ex ante* savings from their own budget constraint (18). Hence, *ex ante* loanable funds equilibrium (20) must be applied all the time under the exogenous debt money. Accordingly, from the Walras law we must have

$$C + I + G = \underline{\mathrm{Y}} \qquad (Ex\ post\ AD\ =\ Ex\ ante\ \underline{\mathrm{Y}}). \tag{25}$$

In this way, loanable funds IS-LM model is destined such that *ex post* aggregate demand (or income) is always determined, or constrained, by the *ex ante* income.

In order for the *ex post* aggregate demand to determine the *ex post* income Y, as the Keynesian theory asserts under the exogenous debt money, the additional amount of money ΔM^E must be put into circulation *exogenously* such that

$$\Delta M^E = \Delta D_H + \Delta D_P + \Delta D_G - \Delta\underline{\mathrm{LF}} \tag{26}$$

Then, in order for the Walras law to hold, we must have

$$C + I + G = \underline{\mathrm{Y}} + \Delta M^E \iff \Delta\underline{\mathrm{LF}} + \Delta M^E = \Delta D_H + \Delta D_P + \Delta D_G \tag{27}$$

Keen (2014, p.284) attained a similar assertion such that "*ex post* expenditure equal *ex ante* income, plus the velocity of money multiplied by the *ex post* change in debt", which is equal to ΔM^E defined in equation (26).

In order to claim that *ex post* aggregate demand determines *ex post* income, therefore, the loanable funds IS-LM model must have a built-in mechanism to put ΔM^E into circulation automatically (unless accompanied by a corresponding increases in the velocity of money). Only under such circumstance, we have:

$$C + I + G\ (=\ ex\ post\ \mathrm{AD}) \Longrightarrow\ \underline{\mathrm{Y}} + \Delta M^E = Y\ (=\ ex\ post\ \mathrm{Income}) \tag{28}$$

The loanable funds IS-LM model, however, lacks this mechanism of additional money injection. This is why the model failed to explain the Great Depression as discussed in Part I. That is, the flawed assumption of exogenous money discussed in Part I is the same as that of the loanable funds discussed here. This failure can only be fixed when the flawed assumption of loanable funds IS-LM model is replaced with the endogenous debt money, as we discussed similarly in Part I. We will now address this in the next section.

Remarks: It should be noted that the loanable funds IS-LM model itself is not flawed under certain conditions. For instance, the 100% reserve banking system proposed by the Chicago school economists and Irving Fisher (Fisher, 1945) discussed in Part I, and the public money system proposed by (Yamaguchi, 2021a, Part V), are the examples of macroeconomic systems where money stock is exogenously adjusted by the monetary authority. Under such systems, the balance between *ex post* and *ex ante* incomes are constantly adjusted through public money policy to sustain a stable economic growth under price stability.[5] Hence, aggregate demand can be said to determine *ex post* income even by the loanable funds IS-LM model under the public money system. Application of the loanable funds IS-LM model is claimed to be flawed only under the present *debt money* system, not under the exogenous *public money* system.

[5]For the separation of powers, Yamaguchi (2012, 2014, 2015) proposes that public money policy should be implemented by the Public Money Administration (PMA), established as an independent committee under the direct supervision of the legislature such as the Congress in the U.S., the parliament in UK, and the National Diet in Japan. This governance mechanism ensures the PMA is isolated from daily political pressures by other branches of government in fulfilling the price stability objective and other functions as the sole issuer of money as interest-free currency. See Yamaguchi (2010, 2011, 2021a) for ASD-based simulation studies on the topic.

3 Endogenous Money IS-LM Model

The loanable funds IS-LM model presented above is destined to fail, in a similar way as the conventional IS-LM model did in Part I, to explain the Great Depression and Japan's lost 30 years, as well as to depict the effects of Keynesian fiscal and monetary policies due to the assumption that money stock is exogenously given. Now we are in a position to formally present a paradigm shift of IS-LM model with endogenous debt money. Our target is to change the *exogenous* money stock into the *endogenous* money stock with budget equations.

Endogenous Budget of Banks

So far, banks are assumed to act as intermediaries by accepting savings deposits from households and making loans (called loanable funds ΔLF) out of those savings. In the world of banking, their loanable funds are not constrained by savings as banks can create new deposits to finance loans under the fractional reserve banking system. Deposits thus created can be interpreted as the increment of money stock (ΔM^s), because they are used for payments as *functional money*.[6] Let us continue to use the same terminology of the loanable funds (ΔLF), to describe the sources of making loans by banks. Then, budget equation of the banks (18) is now replaced with the following:

$$\Delta LF \quad = \quad \Delta M^s \qquad \text{(Endogenous Deposit Creation)} \tag{29}$$

In other words, the total amount of deposit creation constitutes, at a macro-level, the overarching budget constraint on the domestic sector's loan demands (excluding any incoming cross-border bank loans denominated in foreign currencies).

Consequently money stock M^s is now endogenously obtained by the following:

$$M^s = \int \Delta M^s dt \qquad \text{(Endogenous Money Stock)} \tag{30}$$

We have now added two more unknowns to the loanable funds IS-LM model: ΔM^s and M^s for one additional equation (30). Hence, we need one more equation to complete the model. For this purpose, we bring back the aggregate demand equilibrium (1), which has been removed in the loanable funds IS-LM as a redundant equation from the Walras law. Under the endogenous debt money system, it is no longer redundant because the revised Walras law now becomes

$$P(C + I + G - Y) + \Delta LF - (\Delta D_H + \Delta D_F + \Delta D_G) + S - \Delta M^s \equiv 0 \text{ (WalrasLaw)} \tag{31}$$

Due to the additional equation of savings and increment of money stock ($S - \Delta M^s$), the aggregate demand equilibrium (1) and loanable funds equilibrium (20) can now coexist. Under the loanable funds IS-LM model, this additional equation of savings and money stock was missing. As a result, either the aggregate demand equilibrium or loanable funds equilibrium had to be made redundant.

Endogenous Money IS-LM Model

The further revised IS-LM model is now complete, in which money stock M^s is made to be endogenously created. Let us call this revised model *Endogenous Debt Money IS-LM model with Budgets*, which is hereafter called *endogenous money IS-LM* model in comparison with the

[6] See Yamaguchi (2021a, Chapters 5, 6 and 7) further for the definition of public money, debt money and functional money, and Yamaguchi and Yamaguchi (2021b) for their classification in the Japanese economy.

loanable funds IS-LM model. The endogenous money IS-LM model consists of the following 20 equations; (1) through (10), (11) through (17), (20), (29) and (30) with 20 unknowns:

$$Y, AD, C, I, G, Y_d, T, r, i, L^d, S, I_H, W+\Pi, I_P, \Delta D_H, \Delta D_P, \Delta D_G, \Delta LF, \Delta M^s, M^s$$

and 14 exogenously determined parameters:

$$C_0,\ c,\ T_0,\ t,\ T_r,\ I_0,\ \bar{G},\ P,\ V,\ \alpha,\ a,\ b,\ \pi^e,\ \bar{I}_H.$$

Model Feature 1: Money Stock = Total Debts

We know, both theoretically and empirically, that total money stock is approximated by the total debts from banks held by non-banking private sectors (i.e. households and producers) and the government.[7] Let us denote these debts by D_H, D_P, D_G, respectively. Then, these debts (stocks) can be obtained by integrating their flow amounts of $\Delta D_H, \Delta D_P, \Delta D_G$ such that

$$D_H = \int \Delta D_H dt \qquad \text{(Debts of Households)} \tag{32}$$

$$D_P = \int \Delta D_P dt \qquad \text{(Debts of Producers)} \tag{33}$$

$$D_G = \int \Delta D_G dt \qquad \text{(Debts of Government)} \tag{34}$$

Thus, from the equations (20), (29) and (30), we obtain the following:

$$M^s = \int \Delta LF = \int (\Delta D_H + \Delta D_P + \Delta D_G)dt = D_H + D_P + D_G \tag{35}$$

Accordingly, we have shown that money stock M^s is to be endogenously determined, and equals to the total debts held by households, producers and government under the endogenous money IS-LM model.[8] In the case of discrete formula, equations (32) $\sim$ (34) can be replaced with

$$D_{H_t} = D_{H_{t-1}} + \Delta D_{H_t} \tag{36}$$

$$D_{F_t} = D_{F_{t-1}} + \Delta D_{F_t} \tag{37}$$

$$D_{G_t} = D_{G_{t-1}} + \Delta D_{G_t} \tag{38}$$

where initial stock amounts are given as follows:

$$D_{H_{t-1}} = \bar{D}_H,\ D_{F_{t-1}} = \bar{D}_F,\ D_{G_{t-1}} = \bar{D}_G.$$

This is a more formal statement of the paradigm shift discussed in Part I; *LM* curve is no longer independent of *IS* curve. Both *IS* and *LM* curves are closely linked with one another and must move jointly. Flow amounts of money stock such as $\Delta D_H, \Delta D_P, \Delta D_G$ have to be borrowed from banks. Hence, we now need to consider their budget equations more precisely.

[7] Yamaguchi and Yamaguchi (2021a,b) first observed the money-debt relationship in the case of Japanese Yen (JPY) during a period between 1980-2019. Following the JPY case, Yamaguchi (2021b) examined the money-debt relationship in the United States Dollar (USD) and found that total debts from banks approximate M_2 between 1945-2020. As a reference Yamaguchi (2021b, p.16, figure 9) reports that the correlation coefficient between total debts and M_2 of the U.S. is 0.998 during 1945-2020 and 0.996 during 1980-2020. The money-debt relationship in the USD case was more precisely observed than it did in the JPY case where the correlation coefficient between total debts and M_3 is 0.987 during 1980-2019. Furthermore, the correlation coefficient between total debts and nominal GDP of the U.S. was 0.987 during 1945-2020 and 0.978 during 1980-2020.

[8] Public money such as coins issued by the government only constitutes 0.3% of M_3 in Japan, and negligible in terms of the circulating amount. Thus they are omitted from this endogenous money IS-LM model.

Model Feature 2: Increased Money Stock Ends up with Savings

Let us continue to examine the endogenous money IS-LM model in more detail. At the equilibrium, we have, from the revised Walras law (31):

$$S = \Delta M^s \qquad \text{(Savings as Monetary Increase)} \tag{39}$$

That is, savings are equal to the increased amount of money stock. How should we interpret this relation? When aggregate demand determines (*ex post*) GDP as the Keynesian theory presumes, loanable funds by banks must be first made available to meet the demand for the total flow amounts of debts, which in turn increase money stock ΔM^s. In this way the loanable funds are indeed created endogenously by banks as follows:

$$\Delta D_H + \Delta D_P + \Delta D_G \Rightarrow \Delta LF \Rightarrow \Delta M^s \tag{40}$$

On the other hand, at the equilibrium, aggregate demand determines (*ex post*) GDP such that

$$C + I_H + I_P + G \Rightarrow Y \tag{41}$$

Accordingly, from the Walras law (31) we must have:

$$\Delta M^s \Rightarrow S \tag{42}$$

What does this mean? In the IS-LM models, whether loanable funds or endogenous money model, we assumed that households receive all distributed income of wages and profits ($W + \Pi$). Hence, savings S are defined in equation (11) as the balance between income and expenditure by households and include all kinds of savings made by them. Specifically, those savings are first made as demand deposits, which are then transferred further into time deposits as a leakage from circulation or withdrawn back to demand deposits as re-flows into the monetary circulation as Figure 1 below (next page) illustrates.[9]

Yamaguchi and Yamaguchi (2021b) analyzed the composition of the money-debt relationship in Japan and found that time deposits are approximated by total debts held by non-banking private sectors (such as households and producers), while M_1 is approximated by the government debts in Japan. The similar relationships were observed in the U.S. by Yamaguchi (2021b) (the case in Japan is shown in Figure 19 below). From equations (40) and (42), we could say that debts by households and producers $\Delta D_H + \Delta D_P$ end up with time deposits, and debts incurred by the government ΔD_G end up with demand deposits (which amounts to 86.5% of Japan's M_1 as of the end of 2018) as follows:

$$\Delta M^s \Rightarrow S \Rightarrow \begin{cases} \Delta D_H + \Delta D_P \Rightarrow \text{Time Deposits} \\ \Delta D_G \qquad\qquad \Rightarrow \text{Demand Deposits} \end{cases} \tag{43}$$

This implies that deposit money newly created by banks under the debt money system ends up with savings, which are further broken down into demand (checkable) and time (savings) deposits. In the loanable funds model, savings become the source of loans (and investment). In the endogenous money model, savings become the final leakages of endogenously created

[9] Adopted from Yamaguchi (2021b, figure 1). Under the current fractional reserve system, national governments issue coins indicated by the green box. Government coins are issued and circulated as interest-free stable currencies (*public money*). The rest is all *debt money*. Central banks issue reserve deposits shown at the bottom left corner through the direct lending facility and purchases of financial assets in open market operations. Total money stock are defined as M_2 in most economies. Some central banks, however, define M_3, such as in Japan, to differentiate time deposits held by different depository institutions (banks, postal savings, etc.)

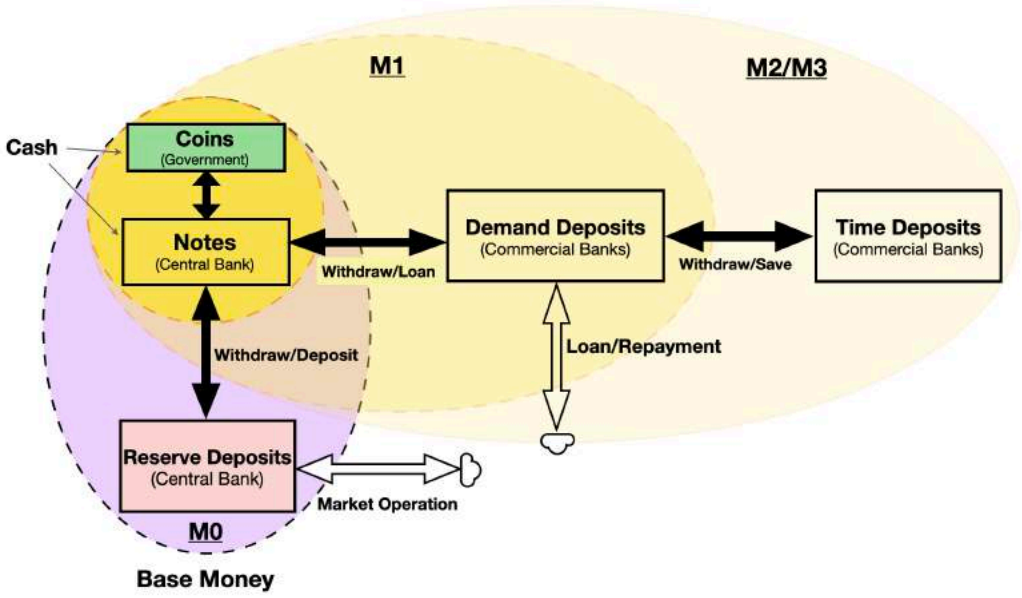

Figure 1: Components of Monetary Aggregates (M_{0-3}) under the Debt Money Systems

money from circulation, which will accumulate as demand and time deposits. This provides a theoretical foundation of our empirical findings in JPY and USD cases as Figure 1 illustrates.

Summary: Against the mainstream macroeconomic theory, which claims that savings determines investment, we have observed completely opposite macroeconomic behaviors; debts determines investment, which then ends up as savings. When aggregate demand (AD) exceeds *ex ante* income $\underline{Y}$, two different macroeconomic behaviors take place under the two different assumptions of loanable funds (exogenous money) and endogenous *debt money* systems:

$$AD > \underline{Y} \quad \Rightarrow \quad \Delta LF = \underline{S} \quad \Rightarrow AD = \underline{Y} \qquad \text{(Loanable Funds)} \tag{44}$$

$$\Rightarrow \quad \Delta LF = \Delta M^s \Rightarrow AD = Y \Rightarrow S \quad \text{(Endogenous Money)} \tag{45}$$

where $\underline{S}$ implies *ex ante* savings, and Y and S imply *ex post* income and savings, respectively.

As discussed in equation (25), (*ex post*) aggregate demand is always constrained by *ex ante* income under the loanable funds IS-LM. In other words it ends up with the Say's law ("supply creates its own demand"). Ironically, the loanable funds IS-LM model, which falsely assumes exogenous money, has played a role of supporting the Say's law even though the Keynes's *General Theory* originally intended to departure from or oppose to it as the 'classical' economics. In the endogenous money IS-LM model, on the other hand, it holds as a truism that (*ex post*) aggregate demand determines *ex post* income as claimed by the Keynesian theory: that is, "demand creates its own supply (production)". Thus, the Keynesian theory must be presented under the endogenous money IS-LM model, which reveals the following features:

- Debt money are endogenously created and destroyed against loans so that central bank has no direct control over the money stock (negation of "exogenous money").
- Investment is not constrained by the loanable funds, but followed by the *ex post* savings (negation of "banks as financial intermediaries").

Our paradigm shift in Part I is now completed in mathematical models with budget equations.

4 Accounting System Dynamics Model of the IS-LM

To confirm this paradigm shift in macroeconomic theory, we will now attempt to construct the loanable funds and endogenous money IS-LM models for comparative simulation analysis. For the analysis of budget equation, the Accounting System Dynamics (ASD) method (Yamaguchi, 2003) turns out to be effective for describing various inter-sector transactions including lending and borrowing of money and debts. Once an integrated model is built, we can then easily run two models within a single model by turning on and off the switch just like the Part I model. In this way the Keynesian controversies, such as described above, can be comparatively analyzed to find out which of the model assumption, i.e. loanable funds or endogenous money, is better suited for the macroeconomic analyses under the current debt money systems.

4.1 Transactions and Balance Sheets of Macroeconomic Sectors

Producers

Let us begin with transactions of producers. In the macroeconomic system, they face two important decisions: production for this year and investment for the futures. As we described in Part I, we have assumed that production decision is made by the desired production in the *IS* sub-model, while investment decision is assumed to be made by the standard macroeconomic investment function (6). Major transactions made by producers based on these main decisions mare illustrated in Figure 2 below (next page) and summarized as follows:

- Producers are constantly in a state of cash flow deficits as analyzed by Yamaguchi (2021a, Chapter 4). To make new investment, therefore, they have to raise funds. Under the loanable funds, they can utilize time deposits that were saved by their shareholders, while in the endogenous money model, they borrow from banks who create new deposits against those loans. Interest payments to banks are not considered here for simplicity.
- Out of the production revenues, producers deduct the amount of depreciation, pay wages to workers and dividends to their shareholders. Various taxes on producers are not considered under the current model. Thus the remaining becomes profits before tax as retained earnings. Wage distribution ratio among workers and shareholders is assumed constant.

Households

Households as consumers have to make two decisions: firstly, how much to consume and how much to save, and secondly, how much to borrow for housing investment. Consumption decision is assumed to be made according to the standard consumption function (3).

Transactions are illustrated in Figure 3 below, some of which are summarized as follows:

- Households receive income as wages and dividends.
- Out of the income as a whole, they pay income taxes, and the remaining amount becomes their disposable income. Interest payments between banks are not considered here.
- Out of their disposable income, they spend on consumption. The remaining is thus saved.
- Households purchase houses from their time deposits in the case of loanable funds, or by borrowing from banks in the case of endogenous money.

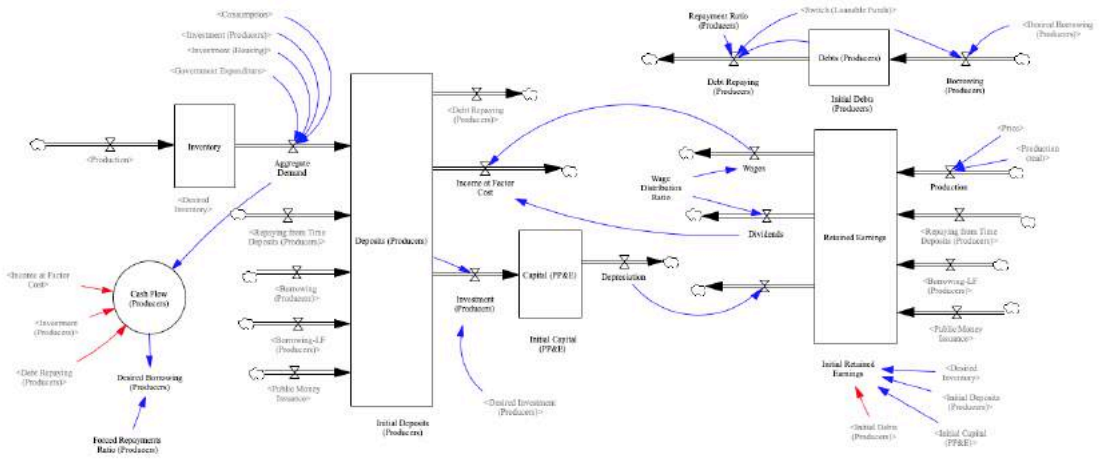

Figure 2: Transactions and Balance Sheet of Producers

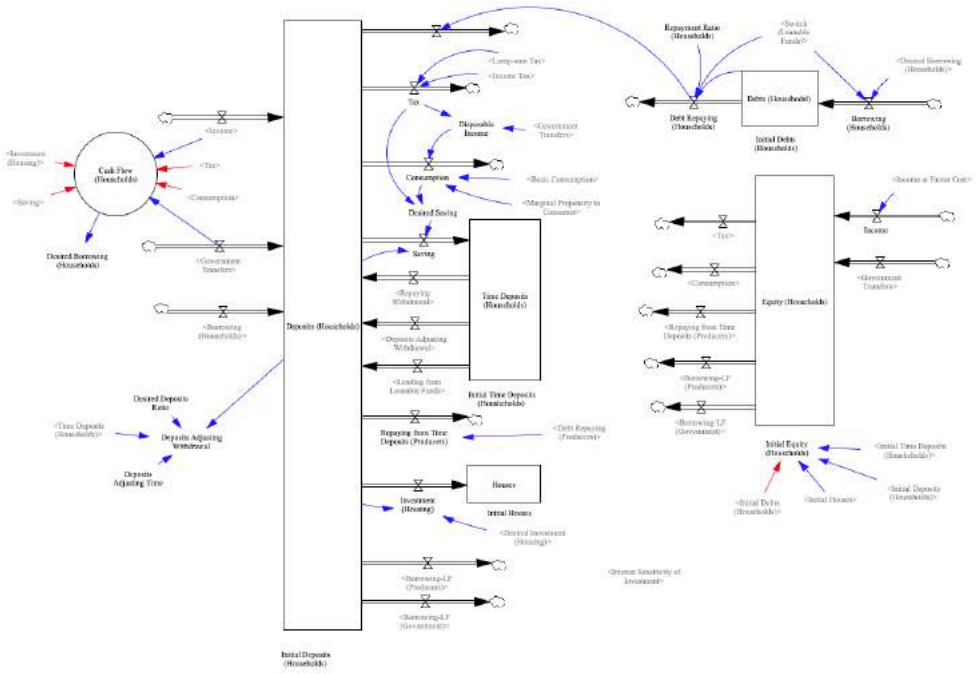

Figure 3: Transactions and Balance Sheet of Households

As explained in Section 2, we have assumed that households receive all distributed income of wages and profits ($W+\Pi$). Hence, savings S are defined in equation (11) as the balance between income and expenditure of households and include all kinds of savings made by the households sector. Those savings are first made as demand deposits, which are then transferred into time deposits as a leakage from monetary circulation, or withdrawn back to demand deposits.

Government

Government faces decisions such as how much taxes to levy as its revenues and how much to spend as expenditures. Tax revenues are assumed to be collected according to the standard formula in equation (5), while expenditures are determined by the revenue-dependent tax and primary balance ratio. Primary balance ratio is assumed to be one by default so that the government budget is in equilibrium at the beginning.

Transactions are illustrated in Figure 4, some of which are summarized below.

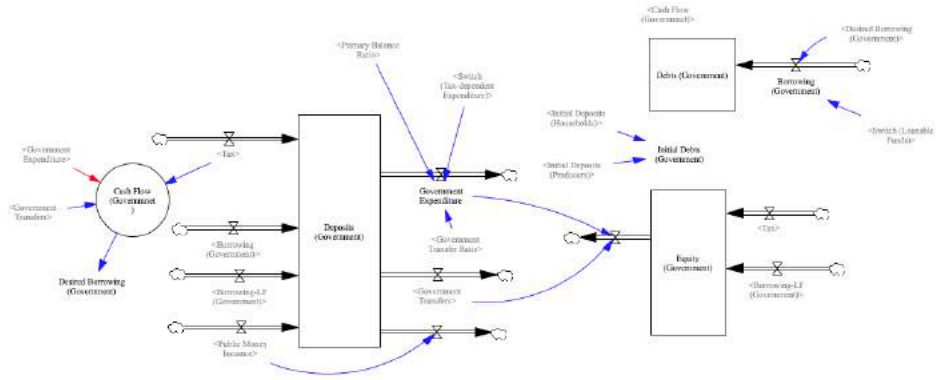

Figure 4: Transactions and Balance Sheet of Government

- Government receives income taxes from households as tax revenues.
- Government spending consists of government expenditures and transfer.
- Government expenditures are assumed to be endogenously determined by tax revenue-dependent expenditures.
- If spending exceeds tax revenues as assumed here, government has to utilize time deposits through banks as intermediaries in the case of loanable funds, or assumed to borrow directly from the central bank for simplicity in the case of endogenous money. Payments involving government are done through banks for simplicity.

Banks

Under the loanable funds case, banks are assumed to act as intermediaries of time deposits from depositors (as savers) to investors (as borrowers). Under the endogenous money model, banks are assumed to play a passive role; that is, they only make loans for the amount asked by producers and households. Furthermore, they do not purchase government bonds and need to make no portfolio decisions among loans and other financial products. Transactions of banks are illustrated in Figure 5, some of which are summarized below.

- Banks receive demand deposits from households and producers, and time deposits from households (interests payments are neglected for a simplicity here).
- In the case of loanable funds, banks make loans out of the savings of time deposits, while in the case of endogenous money, they make loans by creating deposits as much as the desired amount of borrowings by producers and households. Interests on these loans are not considered likewise for a simplicity.

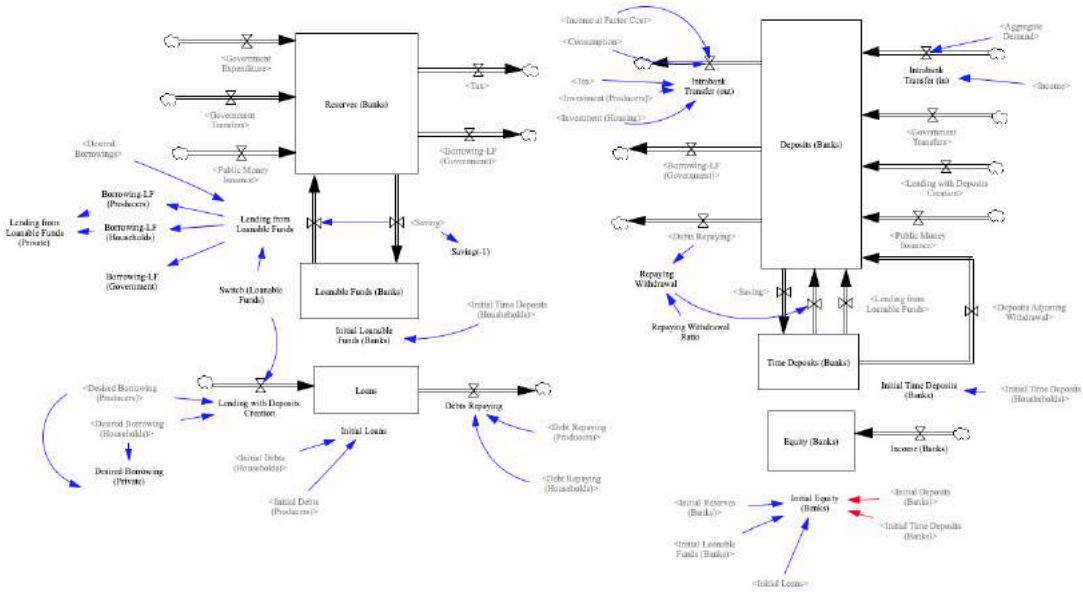

Figure 5: Transactions and Balance Sheet of Banks

Central Bank

The central bank opens deposits accounts for banks and the government. It is assumed to transfer money on behalf of the government, as well as make loans directly to the government in the case of endogenous money. Transactions are made simple and summarized as follows.

- In the case of loanable funds, it is assumed that the central bank transfers funds to the government through reserves of the banks, while in the case of endogenous money, the central bank make loans directly to the government for simplicity.
- As explained at the end of Section 2, the workings of loanable funds model are fundamentally the same and, thus, applicable to that of the public money system. Therefore it is assumed to be able to issue public money as an exceptional case.

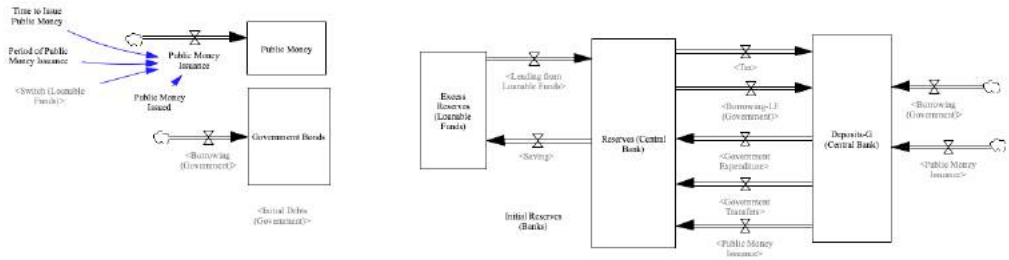

Figure 6: Transactions and Balance Sheet of Central Bank

The LM Sub-Model

With the introduction of budget equations, total amount of money stock can now be obtained within the model as follows:

$$\text{Money Stock } (M^s) = M_1 + M_T \text{ (Time Deposits)} \tag{46}$$

where M_1 is the sum of deposits held by producers, households and government as shown in left end of Figure 7. Demand for money are obtained as the sum of outflows from Deposits. Money Ratio is now modified in Part II model as a moving average ratio of real money stock and demand for money from the previous formulation employed in the Part I model.

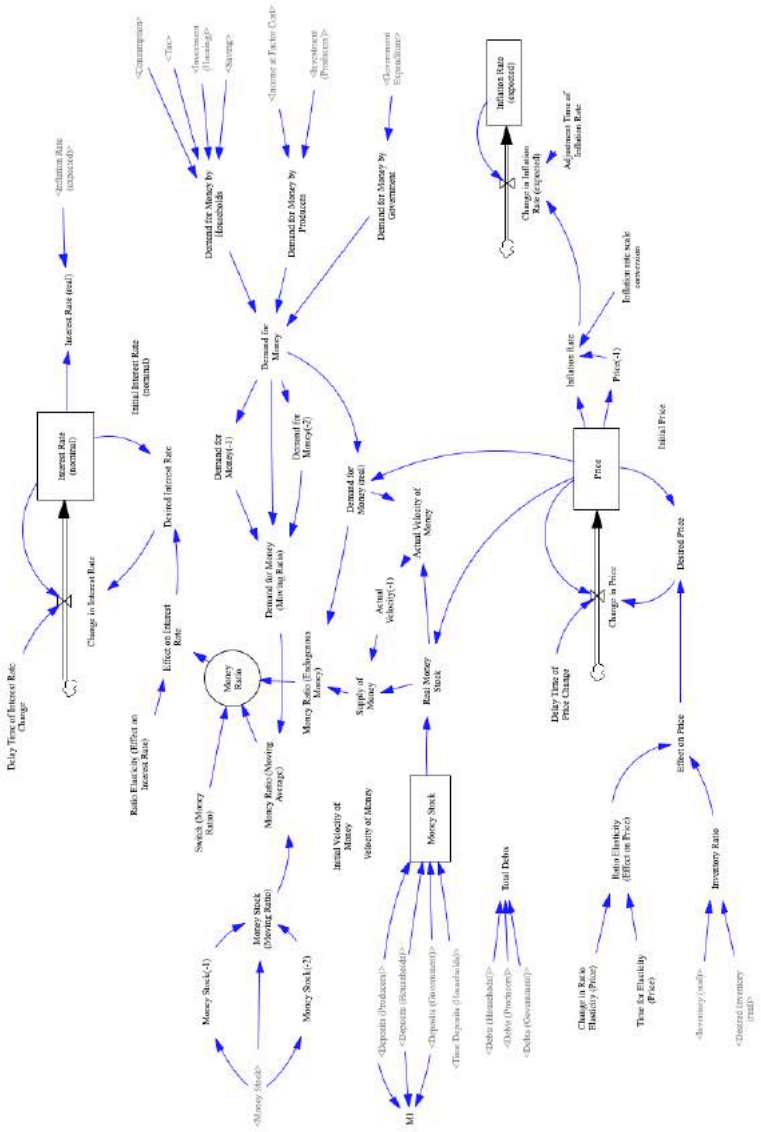

Figure 7: A Model View of the Integrated *LM* Sub-model

4.2 Validations of the ASD Macroeconomic Model

(1) Validation as SD Model: Model and Units Check

Built-in model tests performed by the SD simulation software (Vensim) such as "Check Model" and "Units Check" must be all cleared as a legitimate model. Our model have passed both tests. Recall that we have pointed out in Part I paper that the extended IS-LM model with expected inflation rate presented by Mankiw (2016, Chapter 12) failed this unit check.

(2) Validation as ASD Model: Balance Sheets and Flow-of-Funds Checks

Accounting system requires that balance sheets of all sectors must be in balance. This test is called balance sheets (BS) check. Furthermore, the flow-of-funds framework requires that all assets and liabilities (equity) of all transaction items in the model must be in balance across all macroeconomic sectors involved. This test is called the flow of funds (FF) check. A left diagram of Figure 8 illustrates that, for the Endogenous Money (EM) model, the balance of each sector's balance sheets are almost zero, indicating that the model passes the B/S check for all macroeconomic sectors. The right diagram illustrates that the Flow of Funds are all in balance (almost zero) among transaction items such as deposits, time deposits, reserves, and loans. B/S and F/F checks on Loanable Fund (LF) model are also confirmed.

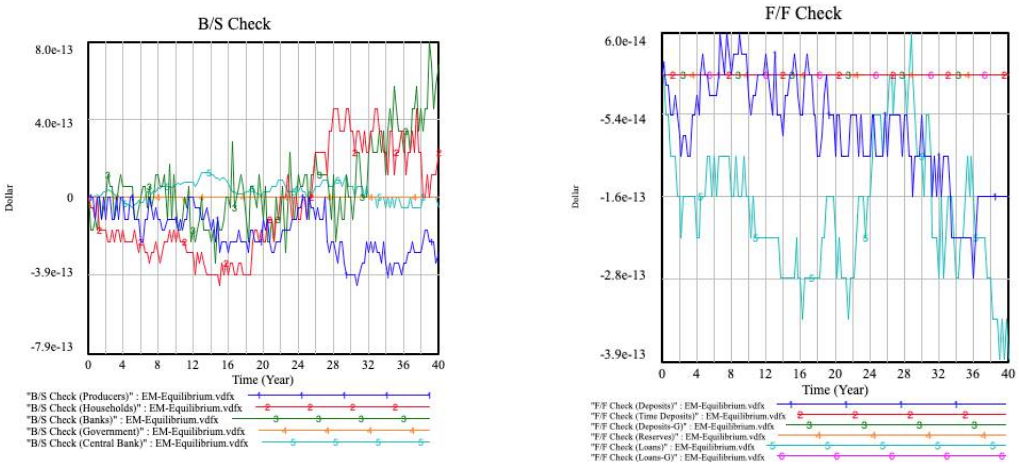

Figure 8: Validation (2) – Balance Sheets (BS) and Flow of Funds (FF) Checks

(3) Validation as Macroeconomic Model: Debt Money Check

We have mathematically shown in the equation (35) that money stock is equal to total debts under the debt money systems. As mentioned in footnote 7, the authors found the following relationships hold in Japan (Yamaguchi and Yamaguchi, 2021a,b) and U.S. (Yamaguchi, 2021b);

1. Money Stock (M_2) $\simeq$ Total Debts (corresponds to line 1 $\simeq$ line 2 in Figure 9)
2. Time Deposits (M_T) $\simeq$ Private Debts (by Producers and Households)
   (corresponds to line 3 $\simeq$ line 4 in Figure 9)
3. M_1 (= Currency + Demand Deposits) $\simeq$ Government Debts
   (corresponds to line 5 $\simeq$ line 6 in Figure 9)

Their empirical findings indicate that the first relation, at least, must hold in any economy operating under the debt money system. Hence, we introduced this additional validation test for macroeconomic models as *Debt Money* check. Figure 9 shows all three relations of Debt Money check hold at the equilibrium under both Loanable Funds and Endogenous Money models.

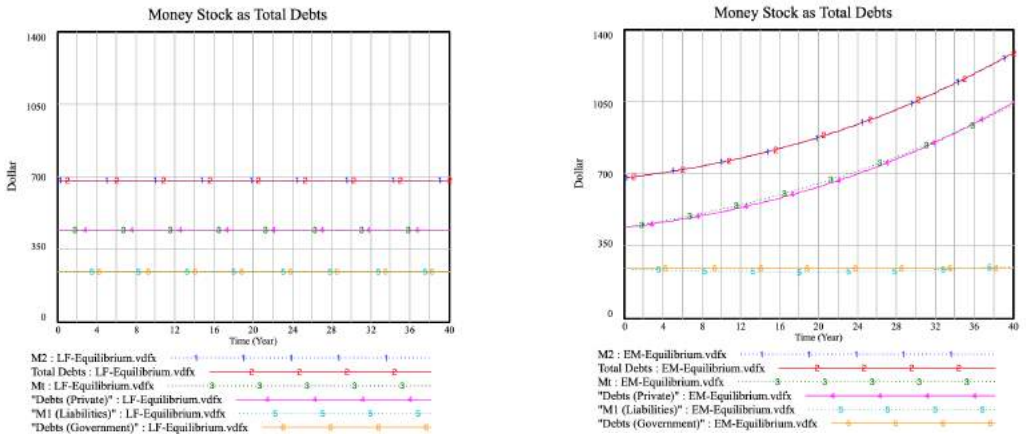

Figure 9: Validation (3) – Debt Money Check: Money Stock $\simeq$ Total Debts

As Yamaguchi (2021b) reports, the second and third relations, which are the breakdown relationships of the first relationship, were also observed in the United States during 1945-2020 following the case of Japan. The empirical findings and our mathematical analysis presented in equation (43) above strongly suggest that the second and third relations could be similarly observed in other currency areas. Depending on the specific case under study, the second and third breakdown relationships may be tested additionally.

5 ASD Model of Loanable Funds and Endogenous Money

Our integrated IS-LM ASD model of loanable funds and endogenous money is now completed. Let us call the loanable funds portion of the IS-LM model simply the LF model, and the endogenous money portion of the IS-LM model the EM model, hereafter. To run the LF model, we simply set a "Money (switch)" value of the integrated IS-LM model to be 1. Its default value is set to be 0 for the EM model as was also the case in Part I model.

Figures 10 and 11 show comparative behaviors of LF and EM models under fixed price. Lines 1 and 2 are behaviors of the EM model at the equilibrium scenario and for the case of investment increase by \$30 at t=10, while lines 3 and 4 are those of the LF model for the same environment. These simulation files name are listed in Table 5.

Endogenous Money IS-LM	Loanable Funds IS-LM
Line 1: EM-Equilibrium	Line 3: LF-Equilibrium
Line 2: EM-Investment(+30)-Fixprice	Line 4: LF-Investment(+30)-Fixprice

Table 1: Simulations under Loanable Funds (LF) vs Endogenous Money (EM) models

Figure 10 presents comparative behaviors of money stock and nominal interest rate. Under fixed price assumption, these nominal values also become real values. Lines 1 (blue) and lines

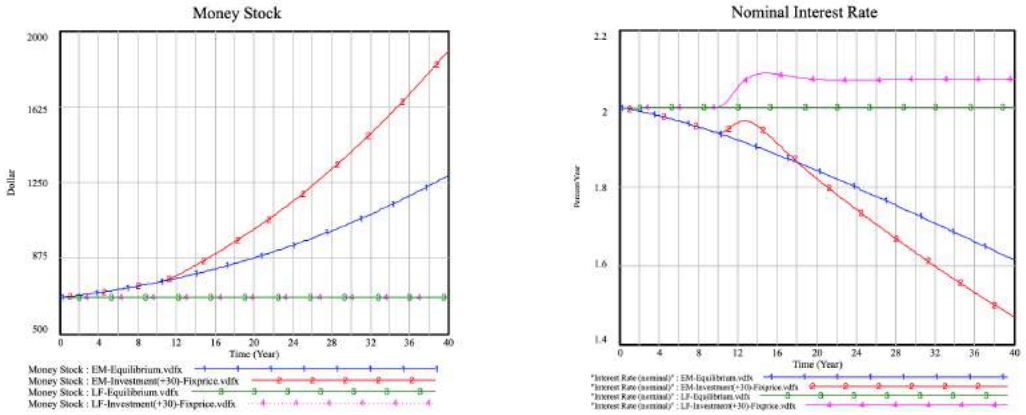

Figure 10: Loanable Funds vs Endogenous Money: Money Stock and Interest Rate

2 (red) indicate steady growth of money stock and gradual declines in interest rate by the EM model. Meanwhile, in the LF model money stocks (lines 3 and 4) do not increase, and interest rate (line 3) stays constant. After the investment increase at t=10, interest rate in the LF model jumps but eventually converges to a constant level (line 4). These different behaviors of interest rate affect investment and, then, income as illustrated in Figure 11. That is, incomes (lines 1 and 2) continue to grow under the EM model due to the endogenous creation of money, while they get stagnated at constant level under the LF model (lines 3 and 4) due to the exogenously fixed amount of money. Right figure shows the IS-LM phase diagram of both EM model and LF model. The EM model indicates a move toward south-east (line1 for equilibrium and line 2 for investment increase), while the move of LF model is confined in a small region (line 3 as dot and line 4).

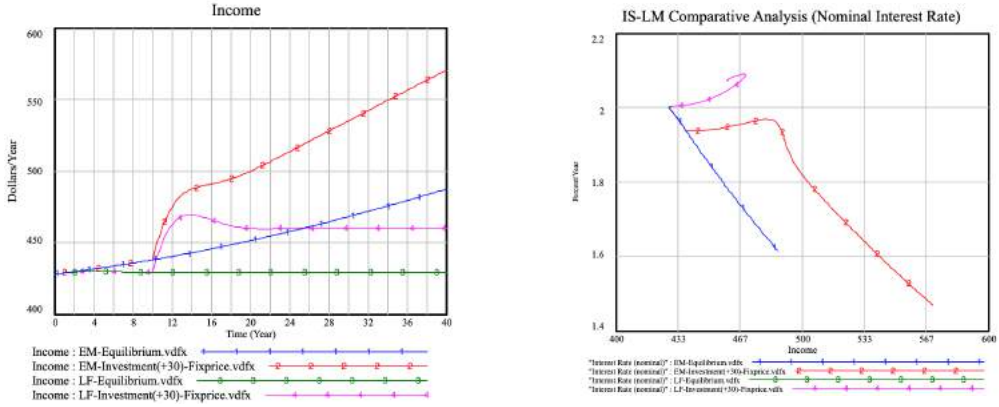

Figure 11: Loanable Funds vs Endogenous Money: Income and IS-LM Phase Diagram

Where do these different macroeconomic behaviors between LF and EM models come from? They are caused by the different attitudes of banks to make loans. Figure 12 illustrates behaviors of desired borrowing, bank lending and saving among EM and LF models. In the EM model, Desired Borrowing (blue line 1) is shown to be always met with Lending with Deposits Creation" (red line 2) without being constrained by the amount of Saving (green line 3). Money is indeed endogenously created to meet the desired investment as indicated by equation (29).

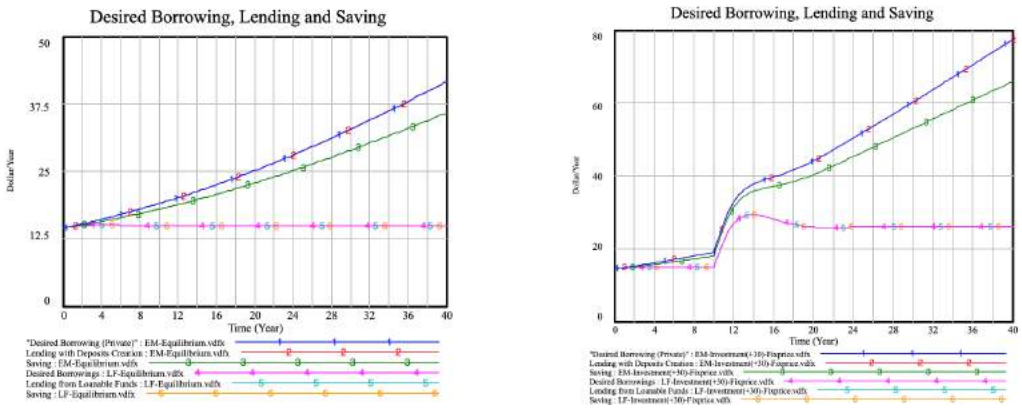

Figure 12: Loanable Funds vs Endogenous Money: Desired Borrowing and Saving

Saving takes place after these investment decisions are made, as indicated by equation (42).

In the LF model, on the other hand, Desired Borrowing (pink line 4) and Lending from Loanable Funds (sky blue line 5) are shown to be constrained all the time by the amount of Saving (orange line 6). These behaviors confirm our mathematical analysis in Section 2. That is, in the LF model, savings become the only sources of desired investment as analyzed by equations (18) and (22). As a result, the constrained relations all the time hold in the LF model such that "Desired Borrowing = Lending from Loanable Funds = Saving."

Having analyzed the behaviors between LF and EM models, we have to decide which model is appropriate for macroeconomic analysis under the debt money system. In the EM model, income is shown to grow and interest rate to decrease as illustrated by lines 1 and 2 in Figure 11. On the other hand, in the LF model money stock does not increase and income is constrained to grow. This is a fatal flaw as a macroeconomic model. In addition, we have rejected the exogenous money IS-LM model in Part I, because it failed to produce the contraction of money stock during the Great Depression. Loanable funds IS-LM model here shares the same flaw as the one in the exogenous money IS-LM model in Part I. Consequently, the LF model has to be similarly rejected here as a model for the macroeconomic analysis of the debt money system in which money is endogenously created and destructed. There is no built-in mechanism of endogenously creating money in the LF model. As discussed in Part I, central bank can only control the amount of base money M_0, but cannot control the amount of M_1 and M_2, or M_3 by its monetary policy. This is a serious design failure of constructing macroeconomic model for the debt money system. Therefore, Keynesian view that money stock is exogenously determined and savings (time deposits) become the sources of loanable funds for investment can no longer be supported, This is the reason why we have argued in Part I that there is a need for a paradigm shift in macroeconomics toward the endogenous money IS-LM model.

Public Money as Loanable Funds

Our rejection of the Keynesian loanable funds model as the one for the analysis of debt money system does not mean that it is of no use as a macroeconomic model. We are just claiming that it is not relevant as a macroeconomic model of the debt money system. Convinced by the visions of monetary reform and 100% money by Irving Fisher, as discussed in Part I of the paper, Yamaguchi (2021a, Part V: Public Money System) and Yamaguchi and Yamguchi (2016) have developed public money system. In this new macroeconomic system money is

constantly put into circulation and withdrawn by the Public Money Administration, and banks only play a role as intermediaries of public money. Accordingly, the Keynesian loanable funds model we have developed so far indeed fits into the economic system of the public money.

In this sense, the LF model could be a candidate for the macroeconomic model of the public money system, but not the one for the debt money system. As a hypothetical situation, let us assume that the Public Money Administration (previous central bank under the debt money system) has injected public money of $40 at t=10 for 30 years; that is, $1,200 in total. That is, money stock (bold line 5) in Figure 13 is shown to increase from $680 to $1,880 for 30 years. Voila! This amount of money under the public money system is issued at interest-free and without causing government debts! Due to this continued injection of public money, income (bold line 5) in the right diagram now increases as much as the one under the debt money system. This is the essence of the public money system.

In this way, it turned out that the loanable funds IS-LM model could serve as a macroeconomic model only under the public money system; it cannot work effectively as a macroeconomic model of the current debt money system in which money is endogenously determined.

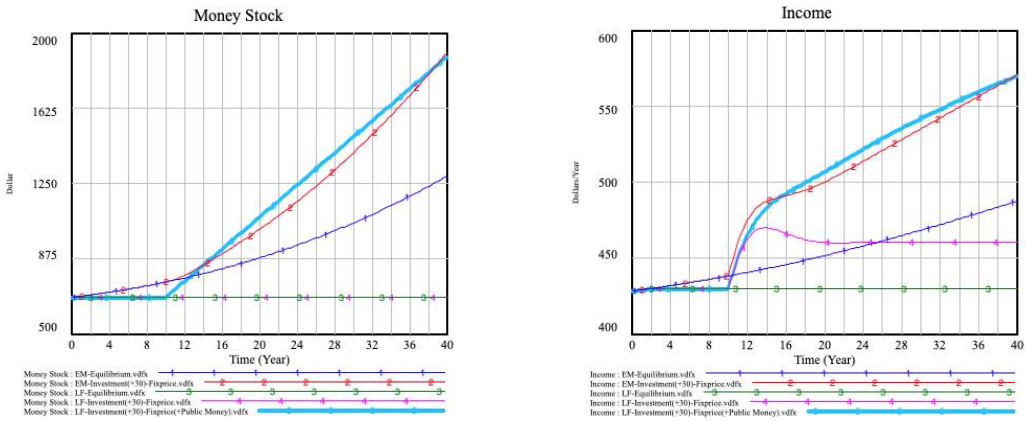

Figure 13: Public Money as Loanable Funds

6 The Great Depression Case Revisited

By introducing the *endogenous money spending hypothesis* discussed in Part I, the EM model developed in Part II has successfully reproduced behaviors of the Great Depression. This time we have not applied PULSE function. We instead used STEP function by setting the parameter values as follows (Δ implies a change): $\Delta C_0 = \Delta I_0 = \Delta \bar{I}_H = -20$ at t=9, 10, 11, respectively. Change in Ratio Elasticity (Price) is set to be 0.06 for flexible price analysis at t=9. Simulation results thus obtained for the Great Depression analysis are shown in Figure 14 through 16. Similar model behaviors as in Part I are obtained.

Table 2 lists corresponding names among each graph legend throughout simulation results shown in Figure 14 through 16. Specifically, the EM model is shown to capture the fall in nominal interest rate, rise in real interest rate, rise in real money balance, and the destabilizing effects of deflation on income discussed in Part I. Figure 16 shows comparative analysis of all simulations in phase diagram where income is taken on the horizontal axis. In the left diagram, nominal interest rate is taken on the vertical axis whereas real interest rate is taken on the right diagram. The reader is advised to visit the analyses in Part I for further details.

Endogenous Money IS-LM	Loanable Funds IS-LM
Line 1: EM-Equilibrium	Line 4: LF-Equilibrium
Line 2: EM-Great Depression-Fixprice	Line 5: LF-Great Depression-Fixprice
LIne 3: EM-Great Depression-Flexprice	Line 6: LF-Great Depression-Flexprice

Table 2: Legend Names for Simulations under The Great Depression Revisited

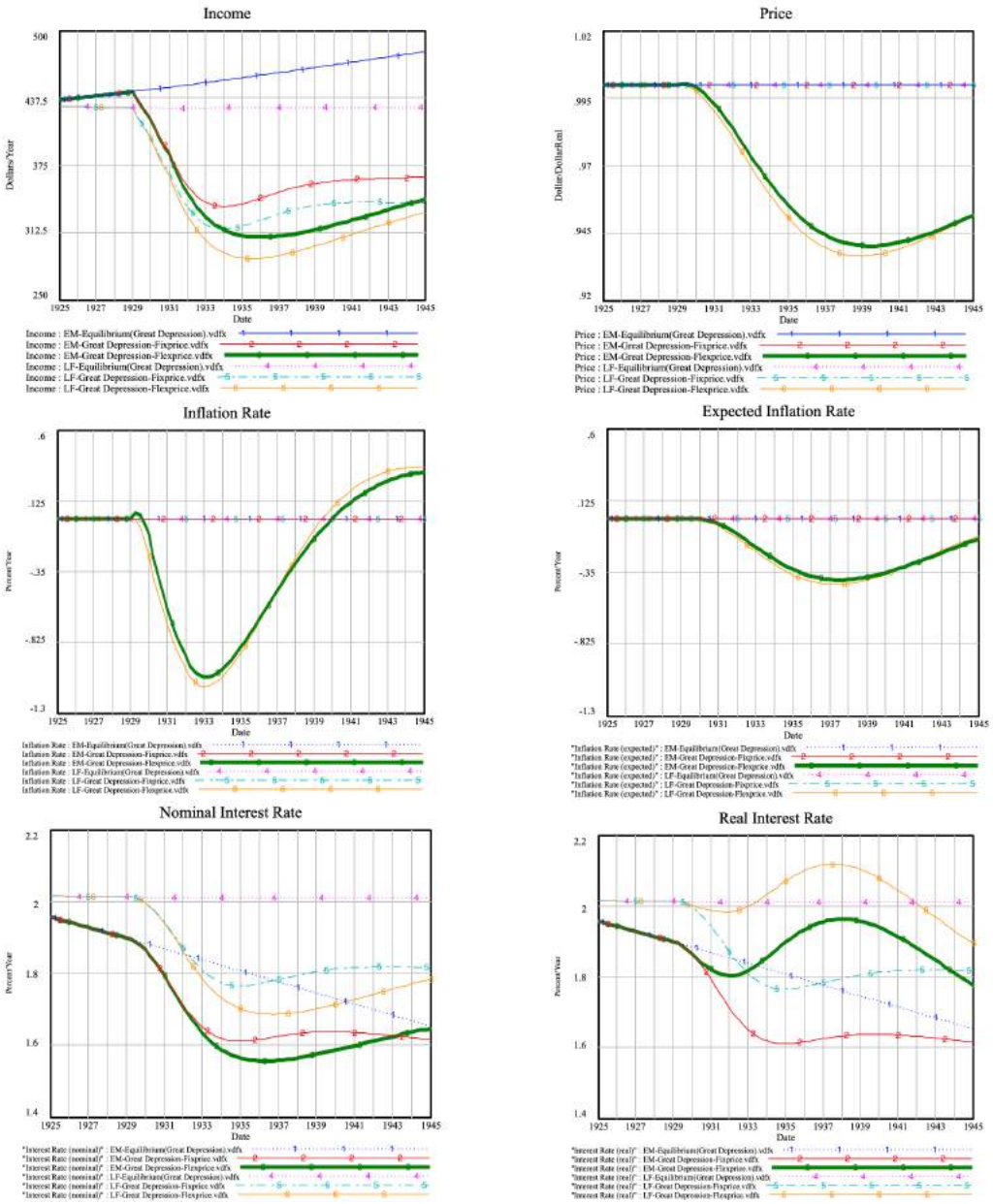

Figure 14: The Great Depression Revisited – Income, Price, Inflation and Interest Rates

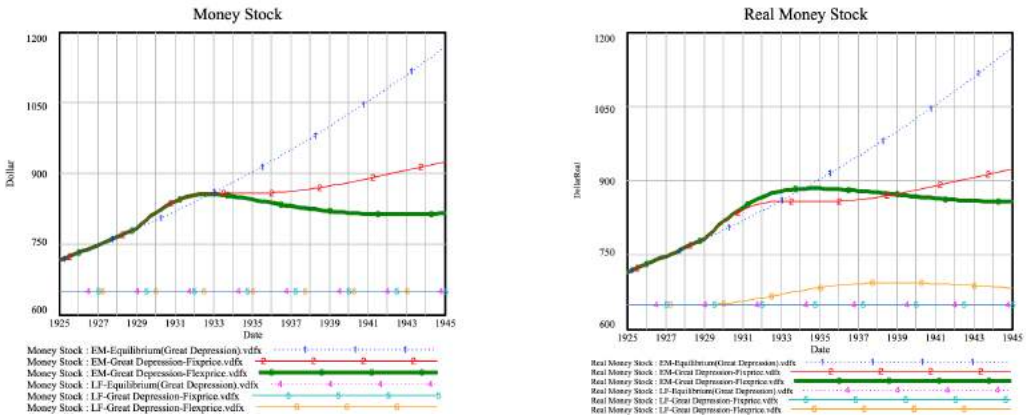

Figure 15: The Great Depression Revisited – Money Stock and Real Money Balance

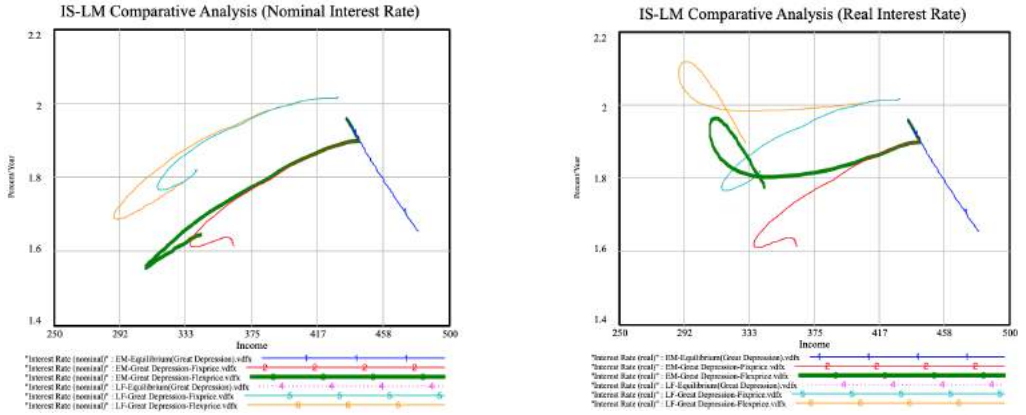

Figure 16: The Great Depression Revisited – IS-LM Phase Diagrams

7 Behaviors of Endogenous Money IS-LM Model

7.1 Japan's Lost 30 Years as Another Great Depression

By applying the endogenous money spending hypothesis, we have successfully reproduced the behaviors of the Japan's lost 30 years by setting the parameter values as follows: $\Delta C_0 = -30$ at t=12, $\Delta I_0 = -90$ at t=12, $\Delta \bar{I}_H = -6$ at t=16. $\Delta \bar{G} = 18$ at t=11. Primary balance is set to be 1. Price is assumed to be flexible by setting Ratio Elasticity (Effect on Price) = 0.06.

Table 3 lists corresponding names among each graph legend throughout simulation results shown in Figures 17 and 18. Lines 2 in red color (legend name: EM-Japan's Great Depression) indicate "what if" behaviors without active fiscal policies of the Japanese government during the lost 30 years. In other words, behaviors presented by lines 2 could be interpreted as the prolonged behaviors of the Great Depression spread over 30 years. Indeed, if they were

Endogenous Money IS-LM	Loanable Funds IS-LM
Line 1: EM-Equilibrium	
Line 2: EM-Japan's Great Depression	(With Fiscal Policy)
Line 3: EM-Japan's Lost 30 Years	Line 4: LF-Japan's Lost 30 Years

Table 3: Legend Names for Simulations under Japan's Lost 30 Years Case

compressed to those of 10 years, they show similar behaviors of the Great Depression (1929-1939) discussed in Part I. We can observe that behaviors of the Japan's lost 30 years are similar to those of the Great Depression in terms of the underlying behavioral patterns in key macroeconomic variables. Therefore, we may conclude that under the debt money system, economic recessions, whether the Great Depression, the Japan's lost 30 years, or any other recessions in general, could exhibit similar behaviors observed under the endogenous money spending hypothesis.

Lines 3 in thick green (legend name: Japan's Lost 30 Years) show simulation behaviors, under the endogenous money spending hypothesis, when fiscal policy is applied. Accordingly, lines 2 and 3 provide comparative behaviors of the Japan's recession cases without or with fiscal policy. For instance, Income shown at the top left of Figure 17 shows that Japan's GDP would have been reduced significantly, almost to the half in the simulation, if the government did not apply the active spending policy.

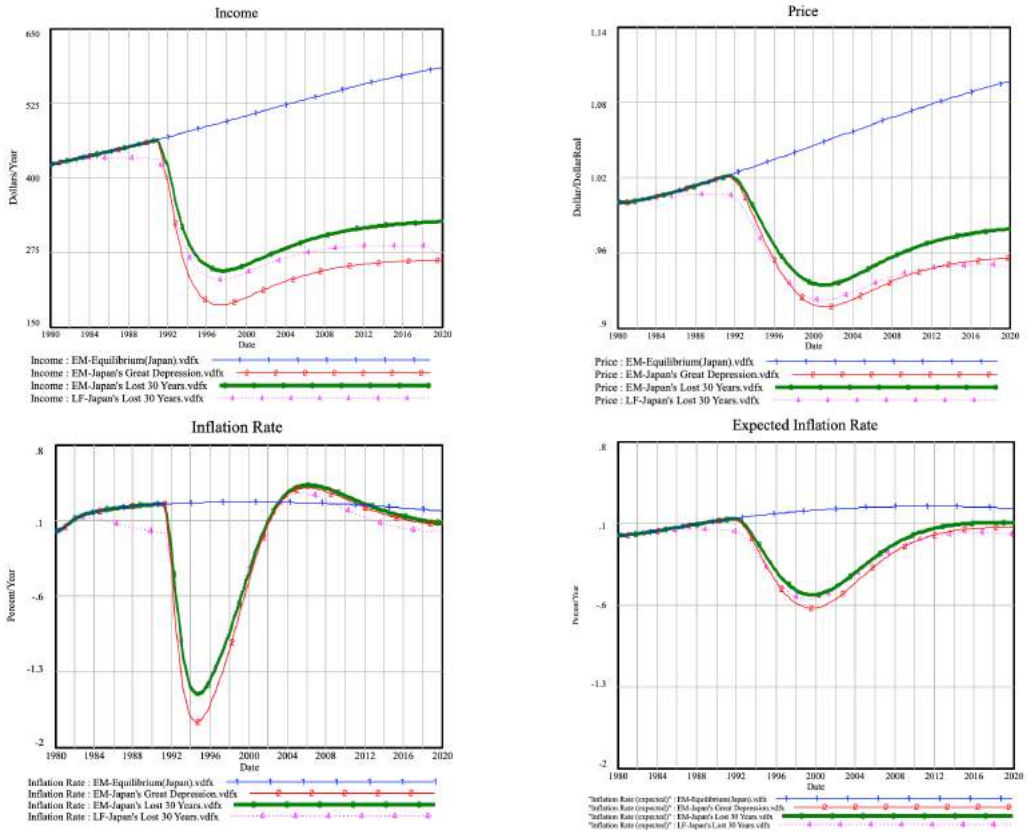

Figure 17: Japan's Lost 30 Years – Income, Price and Inflation Rates

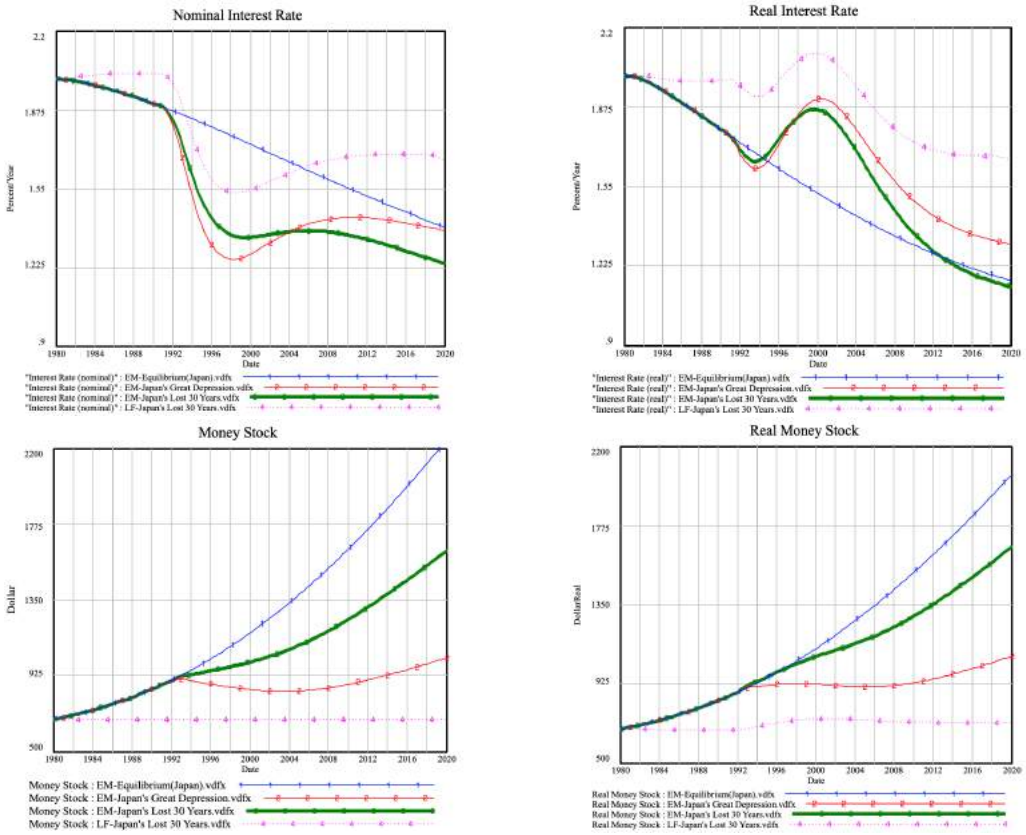

Figure 18: Japan's Lost 30 Years – Interest Rates and Money Stocks

7.2 A Mainstream Myth of A Crowding Out Effect

One of the claims made by the mainstream economics was that if Japan continues to accumulate government debts the economy would sooner or later face with the rising interest due to the so-called crowing-out effects, which reduces investment and cancel out the effects of fiscal policy. Yet, such rises in interest rates did not occur. To examine this claim, we have run simulations under the loanable funds model (lines 4 in Figures 17 and 18). Indeed, line 4 in the diagram of nominal interest rate in Figure 18 shows that nominal interest rate is increasing as the government debts continues to increase under fiscal policy during the lost 30 years.

On the contrary, nominal interest rates continued to decline during the lost 30 years in Japan. Line 3 of endogenous money IS-LM model in the same diagram illustrates this continued decline of nominal interest rate. This declining nominal interest rate has been a puzzle for the mainstream economists whose mindsets are occupied by the loanable funds model (exogenous money). Our EM model indicates that money stock (line 3 of the money stock diagram in Figure 18) continues to increase due to the accumulated debts by the government, which pushes down the nominal interest rate. This is another example that shows the mainstream theory of

loanable funds model is flawed.

Interestingly, real interest rate temporarily rises, then continues to decline, even under the loanable funds model. Mainstream theory of exogenous money failed to show this behavior of real interest rate as well.

7.3 The Money-Debt Relationships and their Decomposition

Let us continue our analysis, using only the endogenous money IS-LM model. We have observed three surprising monetary relations as illustrated in the top left diagram of Figure 19 (Yamaguchi and Yamaguchi, 2021b). Specifically, we have found the following correlations:

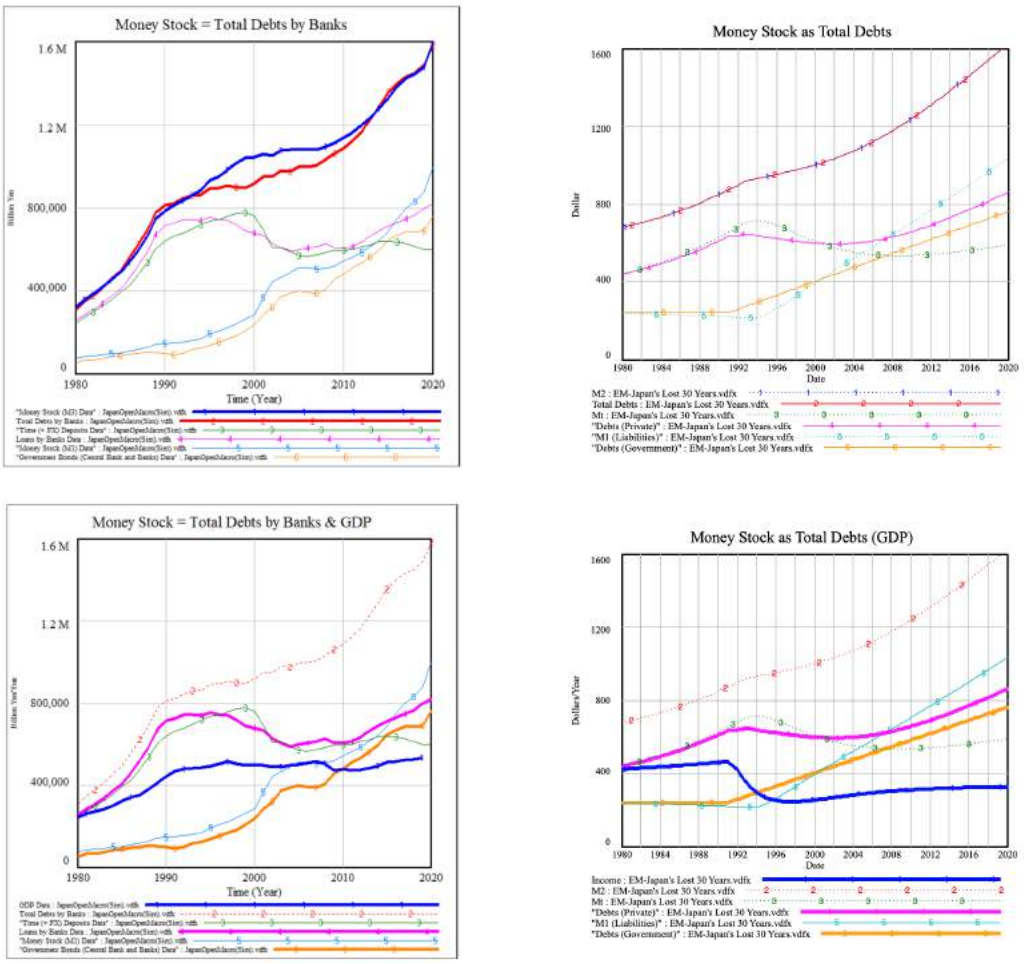

Figure 19: Money-Debt Relationship in Japan and its Decomposition Analyses

- Money Stock (M_3) $\simeq$ Total Debts (corr.coef = 0.987)
  (line 1 $\simeq$ line 2 in the top left diagram of Figure 19)
- Time Deposits (M_T) $\simeq$ Private Debts (by Producers and Households)
  (corr.coef = 0.928) (line 3 $\simeq$ line 4 in the same diagram)

- M_1 (= Currency + Demand Deposits) $\simeq$ Government Debts
  (corr.coef = 0.992) (line 5 $\simeq$ line 6 in the same diagram)

The diagram on top right in Figure 19 shows that our EM model can successfully produce money-debt breakdown relations as observed in Japan. Specifically, money stock (line 1) is shown to be always equal to total debts (line 2) in the model. This confirms that the equation (35) we presented above holds true in the EM model of the debt money system. Under the present system, money is created only when producers, households and government come to borrow from banks at interest. Bankers receive interests on those loans that are created as borrowers' deposits out of nothing.

Our endogenous money IS-LM model can successfully reproduce these macroeconomic relations of money stock such as M_1, M_T, M_2, M_3 and debts by producers, households, and government. Hence, the EM model would also help analyze and identify system structures underlying the macroeconomic behaviors of debt money by manipulating the model parameter values. In this sense, the endogenous money IS-LM model developed in this Part II can be used as a standard IS-LM model for explaining the paradigm shift in macroeconomics we have emphasized in this paper series.

7.4 Japan's Lost 30 Years as Joint Shifts of IS-LM Curves

For our EM model to be a standard IS-LM model in macroeconomics, it has to be able to solve the limitation of the short-run IS-LM model discussed in the Introduction. Specifically, we have to be able to produce "point J" indicated in Figure 18 of the Part I paper.

Figure 20 presents the phase diagrams of the behaviors of Japan's lost 30 years produced by the EM model in terms of nominal (left) and real interest rate (right), respectively. Lines 3 in green indicates that Income or GDP continued to decline in the beginning but failed to recover in spite of the aggressive fiscal policy by the Japanese government, while interest rate continued to decline against the mainstream claim of the crowding-out effect. These model behaviors toward "point J" are similar to what have been observed during the last lost 30 years in Japan. Lines 2 (red), on the other hand, indicate how GDP and nominal interest rate would have continued to decline if no fiscal policy were applied in Japan.

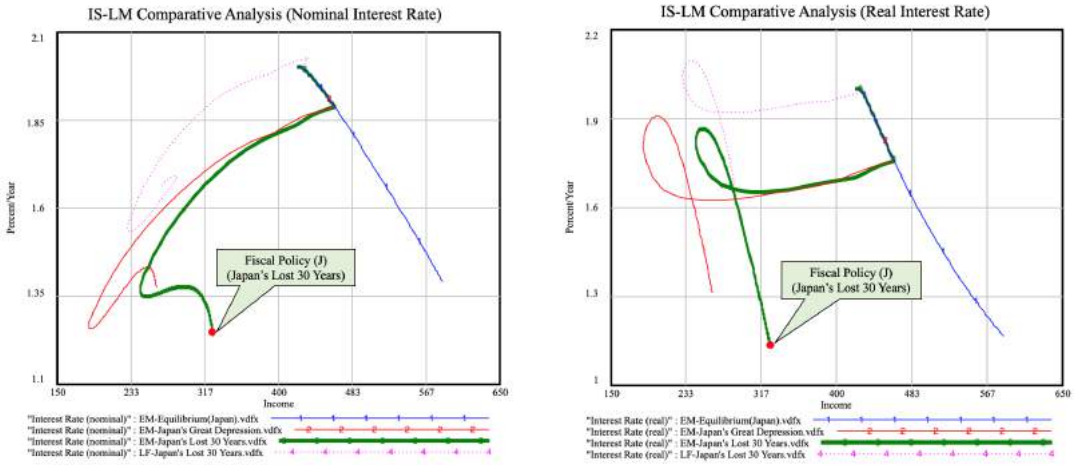

Figure 20: Phase Diagram: Income vs Nominal (Real) Interest Rate

Now we have successfully captured the behaviors of Japan's lost 30 years with the endogenous money IS-LM model developed in Part II. These results seem to show that similar macroeconomic behaviors of recessions could be produced by this EM model. By calibrating the model behaviors to actual case studies, the model could be used by policy-makers to examine potential impacts of monetary and fiscal policy on their economy before its implementation. Indeed, we have obtained the model of paradigm shift proposed in this series.

Conclusion

In Part I and II of the series titled "The Endogenous Money IS-LM Model of the Debt Money System", we have attained the following macroeconomic views against the Keynesian view:

1. We first presented the Keynesian short-run IS-LM model in Part I paper as a mathematical model of equations and system dynamics simulation model. The standard IS-LM model with exogenous money and fixed price assumptions, among others, is shown to be flawed in the sense that it cannot explain the typical macroeconomic behaviors such as observed during the Great Depression and the recent case of Japan's lost 30 years.

2. On the other hand, the revised IS-LM model with endogenous money and flexible price is shown to explain the behaviors of the Great Depression successfully under the *endogenous money spending hypothesis*, which integrates the spending hypothesis proposed by Keynes and money hypothesis as originally proposed by Fisher both in the same year of 1935.

3. The explanatory limitation of the conventional IS-LM analysis is due to the above model assumptions. This renders the Keynesian IS-LM model, in which *IS* and *LM* curves are shifted separately for macroeconomic policy analysis, no longer valid as a reliable model of the economy under the fractional reserve banking system where money stock is endogenously determined by total debts by banks.

4. Under the current debt money system, *IS* and *LM* curves must therefore move jointly or simultaneously in the phase diagram of income and interest rate. This joint shifts of both *IS* and *LM* curves can occur as wide as the phase diagram allow, and thus, makes the movement of IS-LM equilibrium point unpredictable.

5. This has led us to identify a methodological problem of the traditional comparative static analysis that shifting either *IS* or *LM* curve separately and observing its impact on the economy, as we have been thoroughly taught by macroeconomic textbooks, is also no longer applicable for analyses of recessions. For the analysis of recessions under the current debt money system, both *IS* and *LM* curves must be jointly shifted all the time.

6. Yet, due to the simple mechanistic assumption that endogenous money is artificially implemented according to the growth rate of income, this endogenous money IS-LM model presented in Part I failed to produce the behaviors of Japan's lost 30 years, which is the another case the mainstream models failed to provide a systematic explanation.

7. To overcome this limitation, we have expanded the Keynesian short-run IS-LM model in Part II by incorporating the budget equations of domestic sectors as mathematical models first, and then, as the Accounting System Dynamics (ASD) macroeconomic models.

8. The first model constructed based on the exogenous money assumption is called *Loanable Funds IS-LM* model. The model failed to support the Keynesian view that aggregate

demand creates its supply (production). At this stage of our research we are convinced the Keynesian view of exogenous money can no longer hold as the macroeconomic theory of the current debt money system. It is, however, as we have demonstrated in this paper, effective under the public money system where total money stock is fully controlled.

9. The second model constructed based on the *endogenous money spending hypothesis* is called *Endogenous Money IS-LM* model. It is able to successfully reproduce similar behaviors of the Great Depression as analyzed in Part I, but this time, without relying on the mechanistic approach for endogenous money creation and destruction. Then, the model is shown to produce "point J" as a representative case of the Japan's lost 30 years. The *Endogenous Money IS-LM* model presented in Part II can be applied to study the major economic recessions in history under the *endogenous money spending hypothesis*.

10. Furthermore the *Endogenous Money IS-LM* model is shown to produce the money-debt relationship and its decomposition observed in the U.S. and Japan. Accordingly, endogenous money must be the core component of any macroeconomic models under the current debt money system. All textbooks that still apply the traditional IS-LM analysis must now be rewritten accordingly. The ASD model presented in Part II serves both as a foundation for the paradigm shift in macroeconomics and a new integrated framework for theoretical and real-world case studies in place of the Keynesian models grounded on loanable funds (exogenous money).

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Appendix: Endogenous Money IS-LM Model

$$
\begin{aligned}
Y &= AD && \text{(Aggregate Demand Equilibrium)} && (47)\\
AD &= C + I + G && \text{(Aggregate Demand)} && (48)\\
C &= C_0 + cY_d && \text{(Consumption Decisions)} && (49)\\
Y_d &= Y - T && \text{(Disposable Income)} && (50)\\
T &= T_0 + tY - T_r && \text{(Tax Revenues)} && (51)\\
I &= \frac{I_0}{r} - \alpha r && \text{(Investment Decisions)} && (52)\\
G &= \bar{G} && \text{(Government Expenditures)} && (53)\\
\frac{M^s}{P}V &= L^d && \text{(Equilibrium of Money)} && (54)\\
L^d &= aY - bi && \text{(Demand for Money)} && (55)\\
r &= i - \pi^e && \text{(Fisher Equation)} && (56)
\end{aligned}
$$

$$
\begin{aligned}
PC + PT + PI_H + S &= W + \Pi + \Delta D_H && \text{(Households Budgets)} && (57)\\
W + \Pi &= PY && \text{(Distributed Income)} && (58)\\
PI_H &= \Delta D_H && \text{(Housing Budgets)} && (59)\\
I_H &= \bar{I}_H && \text{(Housing Investment)} && (60)\\
W + \Pi + PI_P &= PY + \Delta D_P && \text{(Producers Budgets)} && (61)\\
I_H + I_P &= I && \text{(Private Investment)} && (62)\\
PG &= PT + \Delta D_G && \text{(Government Budget)} && (63)\\
\Delta D_H + \Delta D_P + \Delta D_G &= \Delta LF && \text{(Loanable Funds of Debts)} && (64)
\end{aligned}
$$

$$
\begin{aligned}
(\Delta LF &= S\ ) && \text{(Savings as Loanable Funds by Banks)}\\
\Delta LF &= \Delta M^s && \text{(Endogenous Deposits Creation)} && (65)\\
M^s &= \int \Delta M^s dt && \text{(Endogenous Money Stock)} && (66)
\end{aligned}
$$

The endogenous money short-run IS-LM model consists of the above 20 equations with 20 unknowns:

$$Y, AD, C, I, G, Y_d, T, i, r, L^d, S, I_H, W + \Pi, I_P, \Delta D_H, \Delta D_P, \Delta D_G, \Delta LF, \Delta M^s, M^s$$

and 14 exogenously determined parameters:

$$C_0,\ c,\ T_0,\ t,\ T_r,\ I_0,\ \bar{G},\ P,\ V,\ \alpha,\ a,\ b,\ \pi^e,\ \bar{I}_H.$$