Part II

Macroeconomic Systems of Debt Money

Chapter 4

Macroeconomic System Overview

This chapter applies the method of accounting system dynamics developed in the previous chapters to the macroeconomic modeling. We start with the description of a simple capitalist market economy with the traditional budget equations. In order to analyze its economic behaviors, then, a slightly revised Goodwin growth cycle model is introduced. Finally, these two approaches are integrated to construct our first monetary macroeconomic model called here a monetary Goodwin model. It is demonstrated how money matters for the economic business cycles. This overview will provide a fundamental framework of our macroeconomic models in the following chapters.

4.1 Macroeconomic System

Macroeconomics is one of the core economic subjects which has been widely taught, with the use of standard textbooks, all over the world by many macro economists. Under such circumstances, are there still something remaining to which system dynamics can contribute, I posed. An affirmative answer to this question has led me to work on the series of macroeconomic modeling in [85, 86, 87, 88, 89]. For instance, macroeconomic variables such as GDP, inventory, investment, price, money supply, interest rate, etc, could be more precisely presented by using a basic concept of stock and flow in system dynamics. Moreover, using SD modeling methods, determination of GDP and creation process of credits and money supply - two essential ingredients of macroeconomics - could be more precisely described as dynamic macroeconomic adjustment processes, compared with a traditional static approach.

System dynamics approach requires to capture macro economy as a holistic system consisting of many parts that are interacting with one another. Specifically, macroeconomic system is viewed here as consisting of six sectors such as the central bank, commercial banks, consumers (households), producers (firms), government and foreign sector. Figure 4.1 illustrates an overview of such macroeconomic system and shows how these macroeconomic sectors interact with one another and exchange goods and services for money.

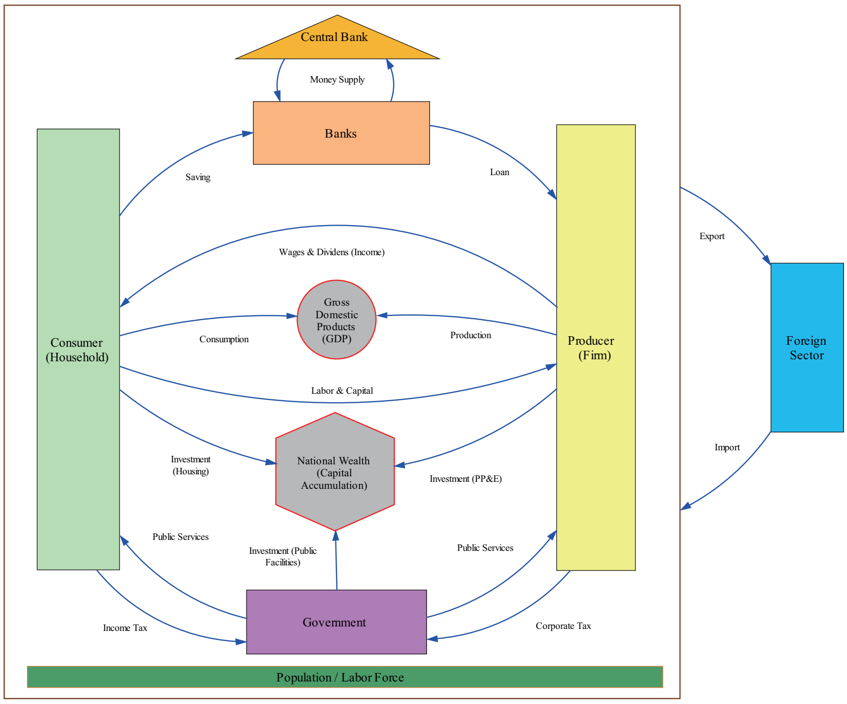

Figure 4.1: Macroeconomic System Overview

In this chapter, we show how to model a macroeconomic system illustrated in the above overview by constructing a simple macro economy consisting only consumers and producers in a capitalist market economy.

4.2 A Capitalist Market Economy

Market economy is an economic system in which goods and services are traded in the markets. A market economy we are currently living in is not the only market economy. For instance, a self-sufficient community, if any, may partly exchange goods and services with another community, or former socialist economies used to trade with another socialist economies. Accordingly, if we extend our concept of economic activities to cover all communities or international economies, their economy also form a kind of market economy. Or the Utopianism economy consisting of co-workers I proposed in [78] as the most suitable economy to the information age is also a market economy.

To distinguish our market economy from these other types of market economy mentioned above, let us call it a capitalist market economy. It is defined as having the following features. It is an economic system which allows private ownership of factors of production such as labor, capital and land. Specifically, workers are allowed to own their labor (thus no longer slaves), shareholders or capitalists can own capital or shares, and landowners can own land and houses for rent. Producers have to organize production activities by purchasing those factors of production from owners in the markets in exchange for wages, profits (or dividends) and rents. The markets where those transactions are made are called labor market, financial capital market, and real estate market. On the other hand, workers and shareholders as consumers have to purchase goods and services in the commodity market. In this way, in a capitalist market economy, all factors of production and goods and services are exchanged in the markets. To make these transactions easy, money as a medium of exchange is invented, whose unit of value becomes a price.

Desired Budget Equations

To describe a market economy as simple as possible without losing generalization, let us consider the economy consisting of workers, shareholders (or capitalists) and producers. Workers and shareholders need not be mutually exclusive. Workers who own corporate shares can also be classified as shareholders. Consumers consist of those workers and shareholders. Their desired budget equations are formally written as follows:

First, workers (W) expect to receive wages against their labor supply and spend them as their income on consumption. The remaining is to be saved. Thus, their desired budget equation becomes

$$pC_W + S_W = wL^s \tag{4.1}$$

where p is a price, C_W is their consumption, S_W is their savings, w is a wage rate, and L^s is labor supply.

Next, shareholders (O) expect to receive profits (dividends) and spend them as their income on consumption. The remaining is to be saved. Then, their desired budget equation becomes

$$pC_O + S_O = \Pi(= pY - wL^d) \tag{4.2}$$

where Π is profits (dividends), C_O is their consumption, S_O is their savings, Y is output (or GDP, Gross Domestic Products, whose concept is assumed to be familiar for the reader), and L^d is their demand for labor.

Finally, producers organize production activities and are assumed to make investment I to expand their production capacity on behalf of shareholders. Since all revenues have to be distributed to workers as wages and shareholders as dividends in a private ownership economy, no fund is left available for new investment. Accordingly, in a capitalist market economy producers are destined all the time to raise fund I^d for investment. Thus, their desired budget equation becomes

$$pI = I^d \tag{4.3}$$

When all of these desired budget equations are added, the following equation is obtained. Since it holds all the time, it becomes an identity, and called Wallas law.

$$p(C_W + C_O + I - Y) + w(L^d - L^s) + (S_W + S_O - I^d) \equiv 0 \tag{4.4}$$

The first component implies an excess demand for goods and services in commodity market, the second one is an excess demand for labor, and the third one is an excess demand for money in financial capital market. Once a capitalist market economy is formalized as above, the major question is whether there exist market prices which clear excess demand in all markets. To be precise, from Wallas law, whenever two markets are in equilibrium, the remaining market attains equilibrium automatically. This problem is called the existence of general equilibrium. As already discussed in Chapter 2, it is proved by Arrow and Debreu.

The next major question is how to find the equilibrium prices. Such a finding process is said to be globally stable if any initial prices can eventually attain the equilibrium through tâatonement processes. As already discussed in chapter 2, an emergence of chaos makes the attainment of equilibrium impossible under some circumstances. It is worth noting again that under the neoclassical framework of price adjustment, transactions can only start when equilibrium is attained. Until that moment, their budget equations are not the actual ones based on the actual receipts and payments. That is why above budget equations are called desired budget equations.

4.3 Modeling a Capitalist Market Economy

Our method of economic analysis is to allow off-equilibrium transactions on a historical time. The accounting system dynamics developed in the previous chapters enables to model the off-equilibrium transactions. Accordingly we are now in a position to model the above simple capitalist market economy as a generic macro economy [Companion model: MicroASD.vpm].

Let us start with producers' balance sheet. Whenever output is produced it becomes their revenues and at the same time booked as inventory. In an actual booking practice of companies, it is usually booked as accounts receivable.

Producers pay wages and dividends to consumers consisting of workers and shareholders, who in turn spend their income on consumption, and the remaining amount is saved. Consumption thus becomes part of producers' sales, which reduces their inventory and increase their stock of cash. Producers also make investment, which in turn becomes sales to other producers. In our integrated

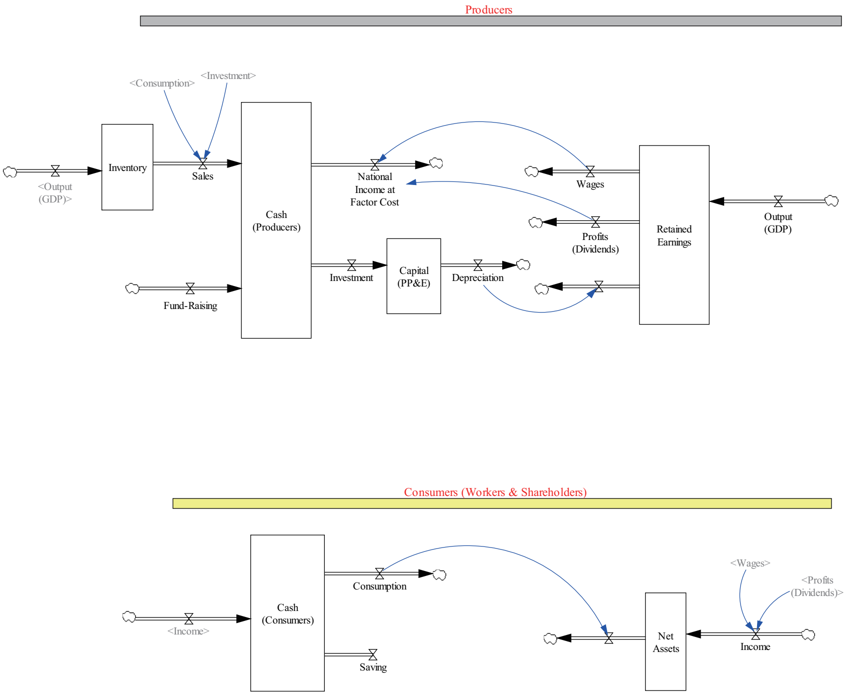

Figure 4.2: Macroeconomic System Flow Chart

stock of producers, these bookings are done in the same stock-flow diagram. Figure 4.2 illustrates our first macroeconomic modeling.

At this point, one remark may be needed. In the model, capital depreciation is added to make our modeling precise. Accordingly, investment in the model has to be interpreted as gross investment consisting of net investment and depreciation. Thus, income that consumers receive is also interpreted as net income; that is, output less depreciation.

Cash Flow of Producers

Let us now calculate net cash flow of producers. It is shown as inflow and outflow of producers' cash stock in Figure 4.3. Thus, it is obtained as follows:

$$\begin{aligned} \text{Net Cash Flow} &= \text{Cash Inflow - Cash Outflow} \\ &= \text{Consumption + Investment} \\ &\quad \text{- Wages - Profits (Dividends) - Investment} \\ &= \text{Consumption - National Income at Factor Cost} \\ &= \text{- Saving} \end{aligned} \tag{4.5}$$

where National Income at Factor Cost is defined as the sum of wages and profits (dividends).

The net cash flow of producers becomes equal to the negative amount of saving. In other words, in a capitalist market economy, producers are all the time in a state of cash deficiency. Accordingly, to make new investment, they are obliged to raise funds. This becomes a fundamental framework of our macro economy.

Theoretically, there are four ways to raise funds as follows:

- Borrowing from banks (bank loans)
- Issuing corporate bonds (borrowing from the public)
- Issuing corporate shares (sharing ownership)
- Retaining earnings for investment (retained saving)

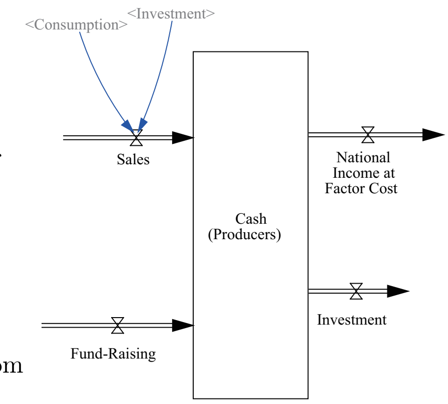

Figure 4.3: Cash Flow of Producers

4.4 Fund-Raising Methods

Bank Loans

Let us consider the fund-raising by bank loans. In this economy, consumers are supposed to deposit their savings with banks, which, in turn, make loans to producers as illustrated in Figure 4.4

In this fund-raising system, banks are merely intermediaries to facilitate the circulation of money as a means of exchange. Historically, however, usury evolved into banking activities, and interests are being imposed on producers. Accordingly, producers are forced to seek for economic growth incessantly to pay interests as well as principals. Remember the previous argument of reinforcing feedback of banking system in Chapter 1. Loans grow exponentially. To repay this increasing amount of loans, production also has to grow exponentially. If economic growth is not attained, those who cannot repay are forced to collapse. Apparently, this incessant growth is not possible under limited resources.

Accordingly, this system of fund-raising has a built-in mechanism of business cycles and economic recessions to be explored below. In addition, this interest-paying system creates unfair income distribution (the rich becomes richer due to the exponential growth), which has to be eventually reset by triggering economic collapses and/or wars, as history tells us. Moreover, forced economic growth is now causing environmental destructions. Accordingly, this interesting-bearing

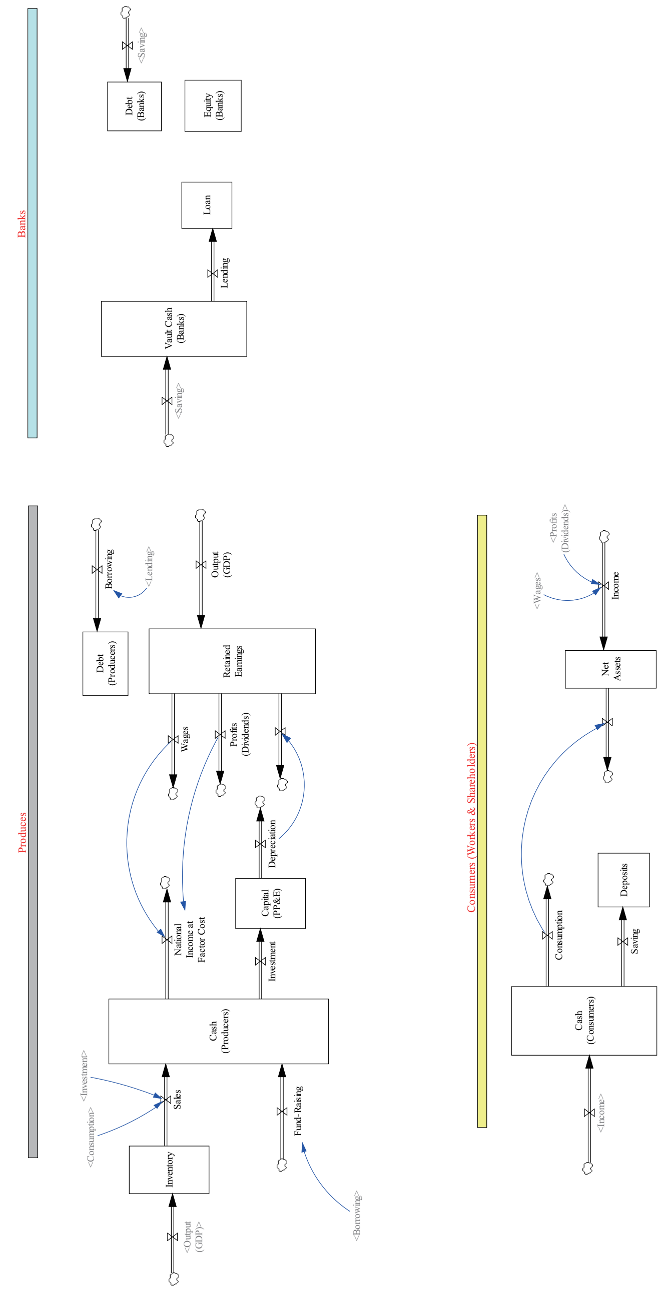

Figure 4.4: A Macroeconomic System Flow Chart with Banks

banking system may not be sustainable. These points are further discussed in Chapter 6.

Securities

In addition to bank loans, fund-raising could be more directly performed by issuing corporate bonds and stocks (shares), which are called securities. To make this fund-raising smooth, we need non-bank investment institutions that can handle these transactions as illustrated in Figure 4.5 [Companion model: MicroASD(NonBank).vpm]. Problem with this fund-raising system is that there exists no way of creating money within the system that is needed to meet the increasing demand for money in a growing economy.

Historically, the above two fund-raising systems with banks and non-bank investment financial institutions co-evolved. And consumers have been provided with diversified portfolio choices among savings, bonds, and shares, while producers have been able to utilize three sources of fund-raising: loans, bonds and shares.

However, roles of banks and non-bank investment institutions have been separated by laws; for in stance, in the United States by the Glass-Steal Act in 1933. Yet, under the strong deregulation forces of free financial activities from the Wall street the Act was repealed in 1999 by the Gram-Leach-Bailey Act. Since then, no clear distinction of financial transactions has been made between commercial banks and investment institutions. This excessive freedom of financial activities began to cause global financial crisis, starting in 2007. This issue will be further explored in Part IV (Chapters 12 and 13).

Retained Earnings

Finally, producers may be allowed to save retained earnings entirely for future's investment, instead of being forced to distribute profits as dividends among shareholders. Japanese auto maker, Toyota, is known for its self-sustained financial management.

System dynamics is the method not only for solving problems, but designing better systems. In this sense, a better economic system of fund-raising would be the one in which producers are possessed by consumers, and no distinction is made between workers and shareholders. In other words, retained earnings become main source of fund. It is called the MuRatopian economy in [78]. In this economy, investment is made first, and the remaining is distributed for consumption, as illustrated in Figure 4.6 [Companion model: MircoASD(MuRatopia).vpm]. Part IV: Macroeconomic System of Public Money will present new system design of macroeconomy.

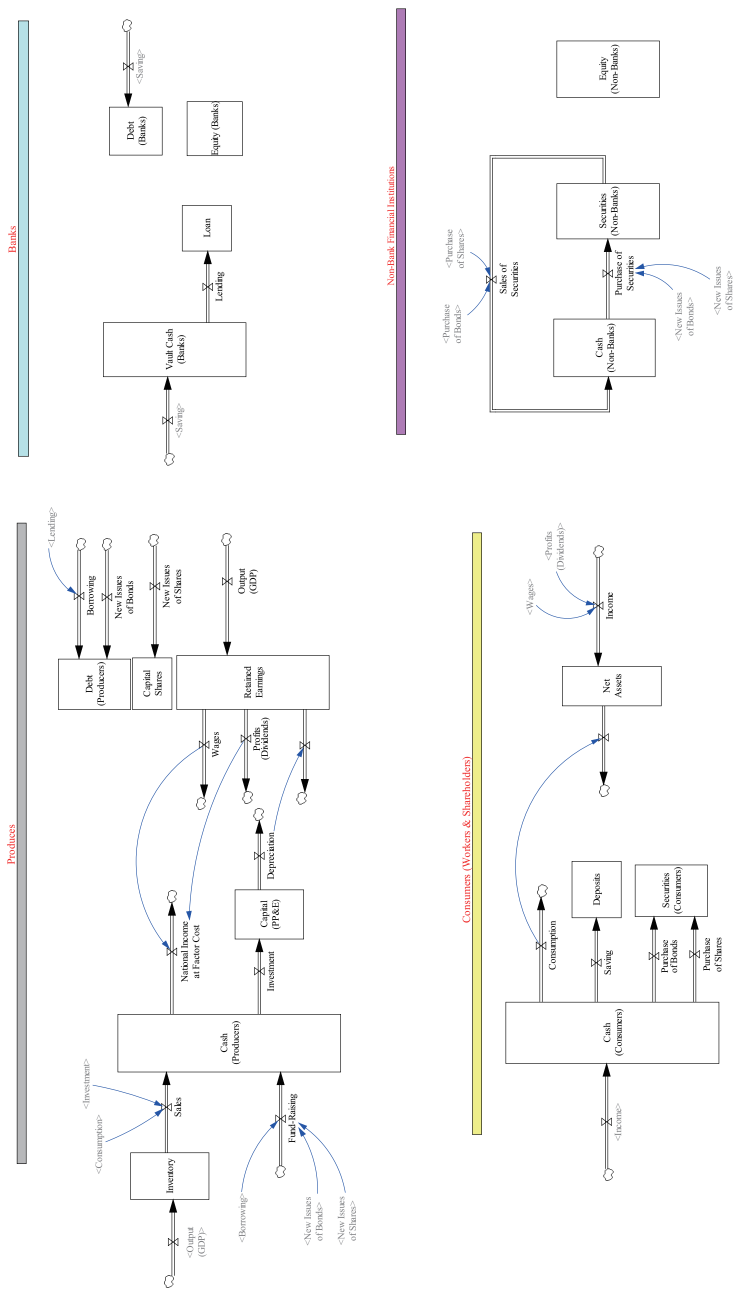

Figure 4.5: A Macroeconomic System Flow Chart with Investment Institutions

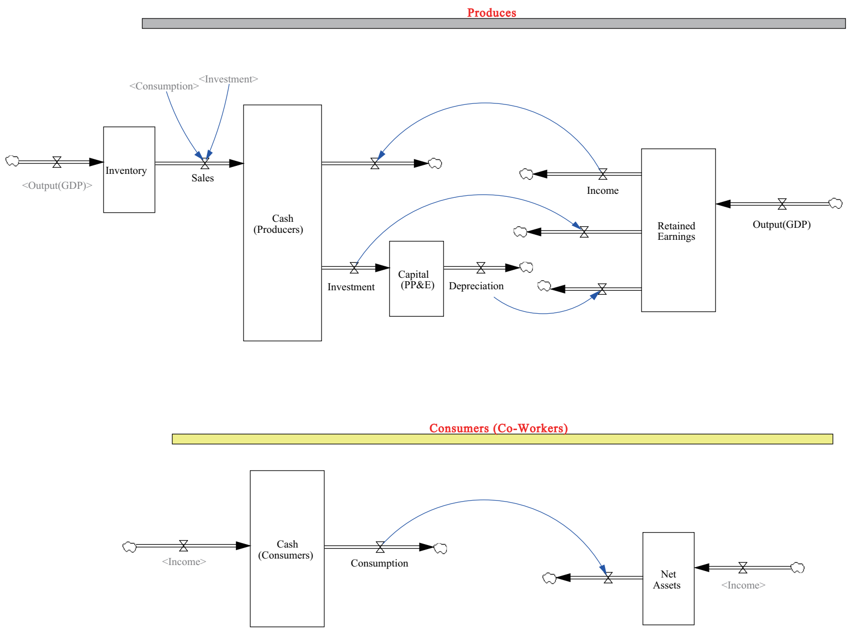

Figure 4.6: Macroeconomic System Flow Chart of Utopianism Economy

4.5 A Goodwin Growth Cycle Model

Let us now construct a simple capitalist macroeconomic model that runs on the monetary flow chart presented above. The most appropriate reference model for this purpose may be the Goodwin growth cycle model [31]. Since its publication, it has drawn attentions of many economists as a classical capitalist economic model that derives endogenous growth/business cycles or economic fluctuations out of class struggles.

The model itself, however, is highly mathematical, using a system of differential equations, and turns out to be very complicated for deriving its economic meaning intuitively. System dynamics modeling method allows us to introduce it more straightforwardly without losing the original spirit of the model. Our revised model consists of 8 equations as follows.

Output or GDP Y is produced by capital K as

$$Y = \frac{K}{\theta} \quad \text{(ProductionFunction)} \tag{4.6}$$

where θ is a capital-output ratio. To produce the output, workers are employed as demand for labor L^d such that

$$L^d = \frac{Y}{\alpha} \quad \text{(Employment)} \tag{4.7}$$

where α is a labor productivity. The level of employment is thus determined by the output.

A wage rate w is determined in the labor market by the following adjustment process:

$$\frac{dw}{dt} = \frac{w^* - w}{AT} \quad \text{(Determination of WageRate)} \tag{4.8}$$

where w^* is a desired wage rate and AT is an adjustment time of wage gap between a desired and actual wage rates. The desired wage rate is defined as

$$w^* = \frac{w}{\left(\frac{L^s}{L^d}\right)^e} \quad \text{(Desired Wage Rate)} \tag{4.9}$$

where (L^s/L^d) is a labor-employment ratio and e is its elasticity of desired wage rate. This is a standard price adjustment mechanism uniformly applied to the determination of prices and wage rate in this book (See Chapter 2); that is, a wage rate is determined by a ratio discrepancy between labor supply L^s and employment L^d and its elasticity[1].

Workers are assumed to consume all of their actual wage income wL^d and do not save; that is, $S_W = 0$. For simplicity price is assumed to be $p = 1$, so that their budget equation (4.1) now becomes

$$C_W = wL^d \quad \text{(Workers' Consumption)} \tag{4.10}$$

On the other hand, capitalists are assumed not to consume; that is, $C_O = 0$, and save the whole amount of profits so that their budget equation (4.2) becomes

$$S_O = \Pi(= Y - wL^d) \quad \text{(Capitalists' Saving)} \tag{4.11}$$

Producers raise fund directly from the saving of capitalists so that their budget equation (4.3) becomes

$$I = I^d = S_O \quad \text{(Investment = Saving = Profits)} \tag{4.12}$$

This equation, accordingly, assumes an equilibrium in a commodity market so that a so-called Say's law is always met; that is to say, supply creates its own demand in this Goodwin economy.

Capital accumulates by the amount of investment less depreciation

$$\frac{dK}{dt} = I - \delta K \quad \text{(Net Capital Accumulation)} \tag{4.13}$$

where δ is a depreciation rate.

[1] In the original Goodwin model, a wage rate is assumed to be determined as a linear approximation of Phillips curve such that

$$\frac{dw}{dt}/w = -\gamma + \rho\left(\frac{L^d}{L^s}\right) \quad \text{(Linearized Phillips Curve)}$$

where γ is an intersection of the y-axis and ρ is its slope. Our standard wage determination process, it is claimed, includes the Phillips curve adjustment.

A slightly revised Goodwin growth cycle model is now complete. This macroeconomic model consists of 8 equations with 8 unknowns; that is, $Y, K, L^d, w, w^*, C_W, S_O, I$, and with 6 exogenously determined parameters whose values are set here at $\theta = 3,\ \alpha = 1,\ L^s = 100,\ AT = 1,\ e = 1,\ \delta = 0.1$.[2]

A causal loop diagram of the Goodwin model in Figure 4.7 illustrates how these 8 unknowns will be interdependently determined. The Goodwin model

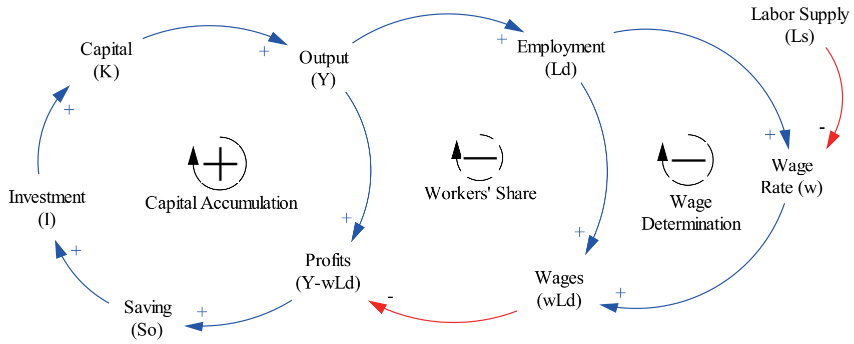

Figure 4.7: Causal loops of A Goodwin Model

consists of one reinforcing feedback loop of capital accumulation and two balancing feedback loops of workers' share and wage determination. Accordingly, its system behaviors depend on which loop becomes dominant. For instance, if the capital accumulation loop governs, the economy may continue to grow. On the other hand, if the workers' share loop dominates, profits and investment shrink and the economy become stagnant.

To analyze these dynamic behaviors, we need to build a Goodwin model of system dynamics. Figure 4.8 illustrates a complete system dynamics Goodwin model[Companion model: Goodwin.vpm]. From the system dynamics viewpoint in Chapter 1, this is a system with two stocks such as capital and wage rate, so that behaviors such as overshoot and collapse and oscillation could be triggered in principle. In this sense, it could also be one of the best macroeconomic examples to learn system behaviors of two stocks.

A Steady-state Equilibrium

In the Goodwin model, an equilibrium of commodity market is assumed to be automatically met as Say's Law, since gross investment is determined to be equal to saving which is equal to profits. Accordingly, market adjustments occur

[2] In the original Goodwin model, supply of labor, L, is assumed to grow at a constant growth rate n such as

$$\frac{dL^s}{dt} = nL^s.$$

For simplicity labor supply is assumed here not to grow. This assumption can be easily removed by the reader.

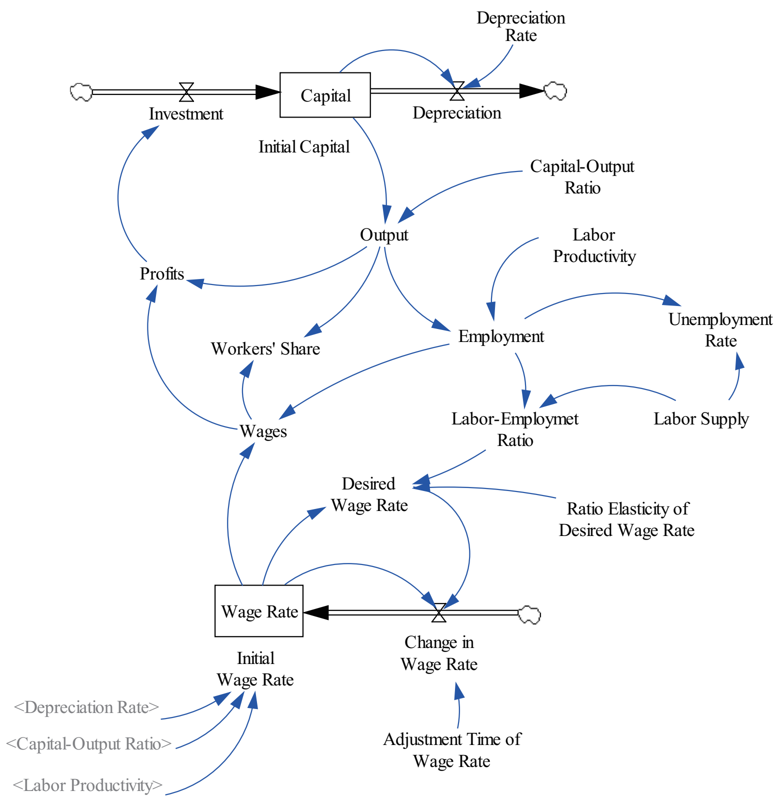

Figure 4.8: A Goodwin Growth Cycle Model

only in the labor market and financial capital markets. From Walras law, if an equilibrium is attained in the labor market, then the equilibrium of financial capital market is also automatically attained. Yet, no financial capital market is explicitly brought to the Goodwin model. Accordingly, a market adjustment has to be sought in the labor market.

With these model structure in mind, let us search for a steady-state equilibrium of the Goodwin system. It can be obtained only when we have $\frac{dK}{dt} = \frac{dw}{dt} = 0$. To attain $\frac{dK}{dt} = 0$, a simple calculation entails that the following equation needs be met:

$$w = (1 - \delta\theta)\alpha \quad \text{(No Capital Accumulation)} \tag{4.14}$$

In our model, this steady-state equilibrium condition is reflected in the initial value of wage rate.

To achieve $\frac{dw}{dt} = 0$, we must have

$$L^s = L^d \quad \text{(Full Employment).} \tag{4.15}$$

Accordingly, the steady-state equilibrium is attained only when $w = (1 - 0.1 \cdot 3) \cdot 1 = 0.7$ and $L^d = L^s = 100$. Lines 1 in Figure 4.9 shows the equilibrium wage rate of 0.7 and output of 100.

Business Cycles

The steady-state equilibrium in the Goodwin model can be broken only when one of the three model parameters change their values from the initial equilibrium conditions at $\theta = 3,\ \alpha = 1,\ L^s = 100$. To explore off-equilibrium economic behaviors, let us focus on the change in the values of labor supply here. The other two cases of parameter value changes will be left to the reader as exercise.

When labor supply is $L^s = 110$, and becomes higher than the equilibrium employment of 100, wage rate begins to decline as indicated by line 2 in the left-hand diagram of Figure 4.9, which simultaneously causes the decrease in workers'share and increases in profits and investment, which in turn expands capital accumulation and output with a delay as indicated by line 2 in the right-hand diagram of output. When labor supply is $L^s = 90$, and becomes less than the equilibrium employment of 100, wage rate begins to increase, and exactly the opposite behaviors start to dominate as lines 3 in both diagrams demonstrate.

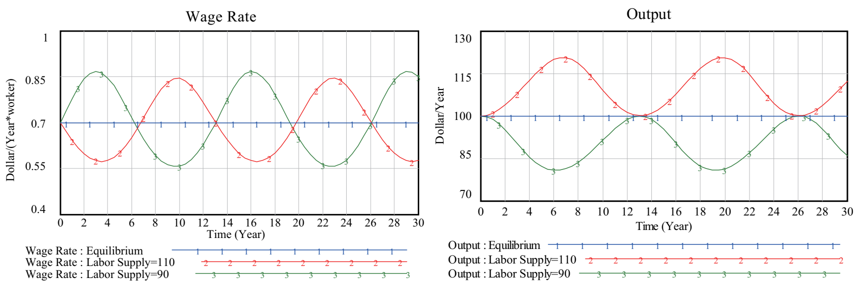

Figure 4.9: Wage Rates and Output

In this way, in the case of $L^s = 110$, wage rate tries to go down and up to attain an equilibrium in the labor market unsuccessfully; that is, employment overshoots and undershoots the labor supply as illustrated by line 2 in Figure 4.10. This fluctuation is caused by the delay in stocks. Similarly, in the case of $L^s = 90$, employment overshoots and undershoots as illustrated by line 4. In other words, equilibrium in the labor market can never be attained in the capitalist market economy due to the delay in system (a well-known behaviors in system dynamics), though wage rate is perfectly flexible as neoclassical economists postulate.

Let us examine this business cycle in detail in the case of $L^s = 110$ by referring to Figure 4.11. Whenever there exists excess labor supply in the labor market, wage rate begins to decline as well as workers' share (line 1). This causes the increase in profits as well as investment (line 2). This increases

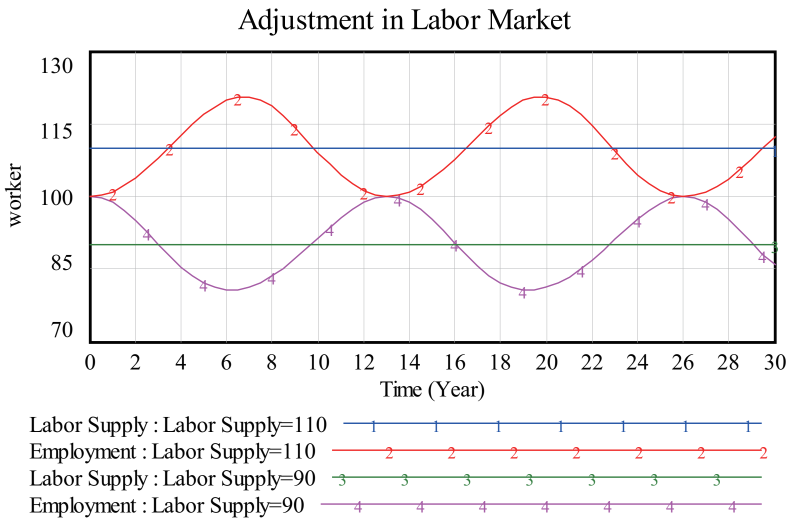

Figure 4.10: Adjustment in Labor Market

capital accumulation with a delay (line 3), which increases output with a delay as well (line 4). The delayed increase in output causes an increase in the demand for employment, causing wage rate to increase with a delay (line 1).

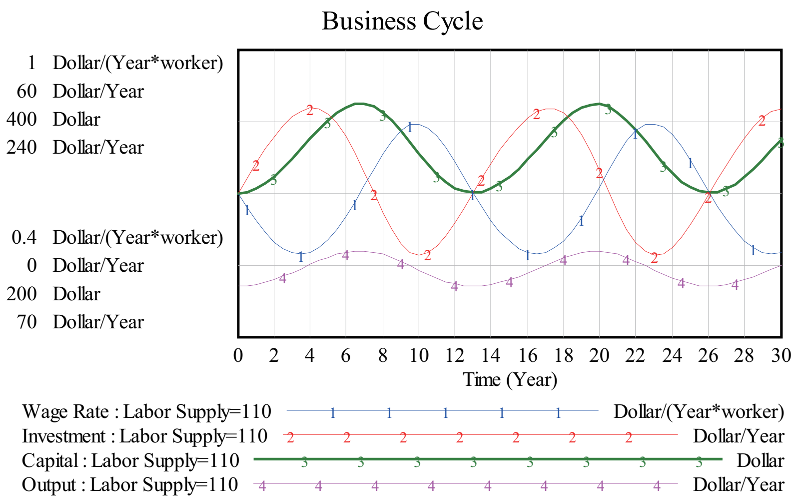

Figure 4.11: Business Cycle

Period of Business Cycles

The period of business cycles depends on how wage rate responds in the labor market; that is, a wage rigidity which is specified by a labor-employment ratio elasticity of desired wage rate in our model. Figure 4.12 illustrates three different business cycles for the disequilibrium case of $L^s = 110$. When the elasticity is 0.4; that is, labor market is rigid, the period of business cycle becomes about 20 years (line 1). When the elasticity is unitary, the period becomes about 13 years (line 2), and becomes about 8 years when the elasticity is 2.4 (line 3); that is, wage rate is very flexible. From these simulations, it can be easily envisioned that as the labor market becomes more flexible, the longer becomes the period of business cycles.

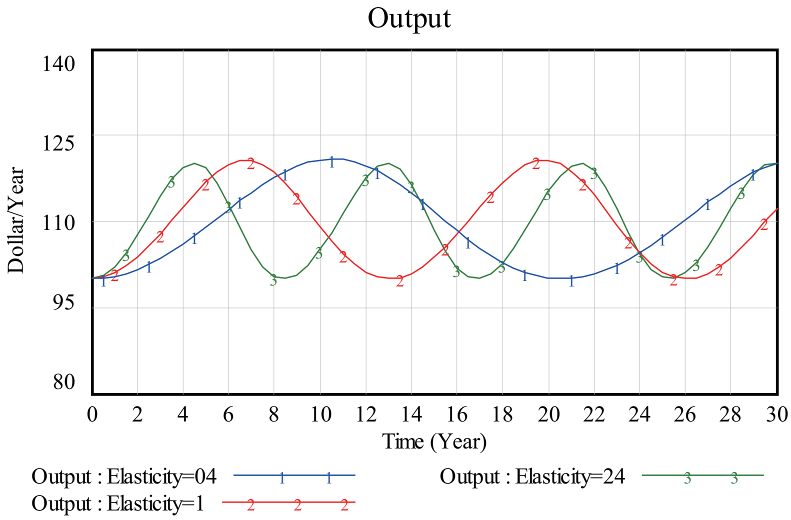

Figure 4.12: Ratio Elasticity of Desired Wage Rate

In this way, our Goodwin growth cycle model has demonstrated that business cycles are endogenously generated within a capitalist market economy, whose periods depend on the wage flexibility in the labor market.

Goodwin's original work illustrated this endogenous growth cycle by his famous phase diagram of employment rate on the y-axis and workers' share on the x-axis. Figure 4.13 illustrates similar phase diagram for different levels of labor supply and elasticity. In our phase diagram, a labor-employment ratio, a reciprocal of Goodwin's employment rate, is used without losing generality. Specifically, the left-hand diagram shows how circular relation between labor-employment ratio and workers' share begins to expand from the equilibrium center of (0.7, 1) as labor supply increases from the equilibrium level of $L^s = 100$ to 102, 104, 110, 114 and 120. Meanwhile, the right-hand diagram shows how this circular relation begin to expand horizontally, under the $L^s = 110$, as the elasticity of desired wage rate increases from $e = 0.2$ to 0.4, 1, 1.8 and 2.4.

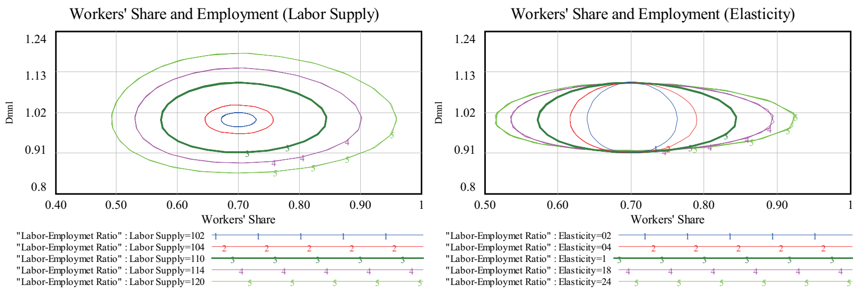

Figure 4.13: Phase Diagram of Labor-Employment Ratio and Workers' Share

4.6 A Monetary Goodwin Model

We are now in a position to unify the above Goodwin growth cycle model of macroeconomic dynamics with our analytical method of the accounting system dynamics, and explore macroeconomic behaviors on a circulation of money. Among four fund-raising methods discussed above, bank loans will be adopted here as a typical fund-raising method for producers. Specifically, a macroeconomic system flow chart with banks in Figure 4.4 is integrated with the Goodwin growth cycle model in Figure 4.8. This integrated Goodwin growth cycle model running on the circulation of money may be called here a monetary Goodwin model. Figure 4.14 illustrates its revised part of the balanced sheet sub-model [Companion model: Goodwin(Money).vpm][3].

A Steady-state under Monetary Constraints

We have already discussed above that a steady-state equilibrium can not be broken unless initial parameter values such as $\theta = 3$, $\alpha = 1$, $L^s = 100$ are changed. At the steady-state, the output becomes 100, out of which workers receive 70 as wages and spend them all on consumption. The remaining amount of 30 becomes profits, all of which in turn are invested. Meanwhile, initial capital stock is 300, 10% of which is assumed to depreciate. Accordingly, to maintain the initial level of capital, depreciation of 30 has to be incessantly replenished by the investment of 30, which will be done out of profits. In this way, the economy is sustained at the steady-state so long as the above-mentioned initial parameter values are held constant, as argued by many growth economists.

Yet, these conditions for the steady-state equilibrium are no longer sufficient whenever a circulation of money is explicitly introduced to the economy. To maintain the steady-state equilibrium in a capitalist market economy, produces

[3]The monetary Goodwin model is the same as Goodwin model. To run this model, the default value of the variable Switch(Cash Constraint)=0 has to be reset to be equal to 1

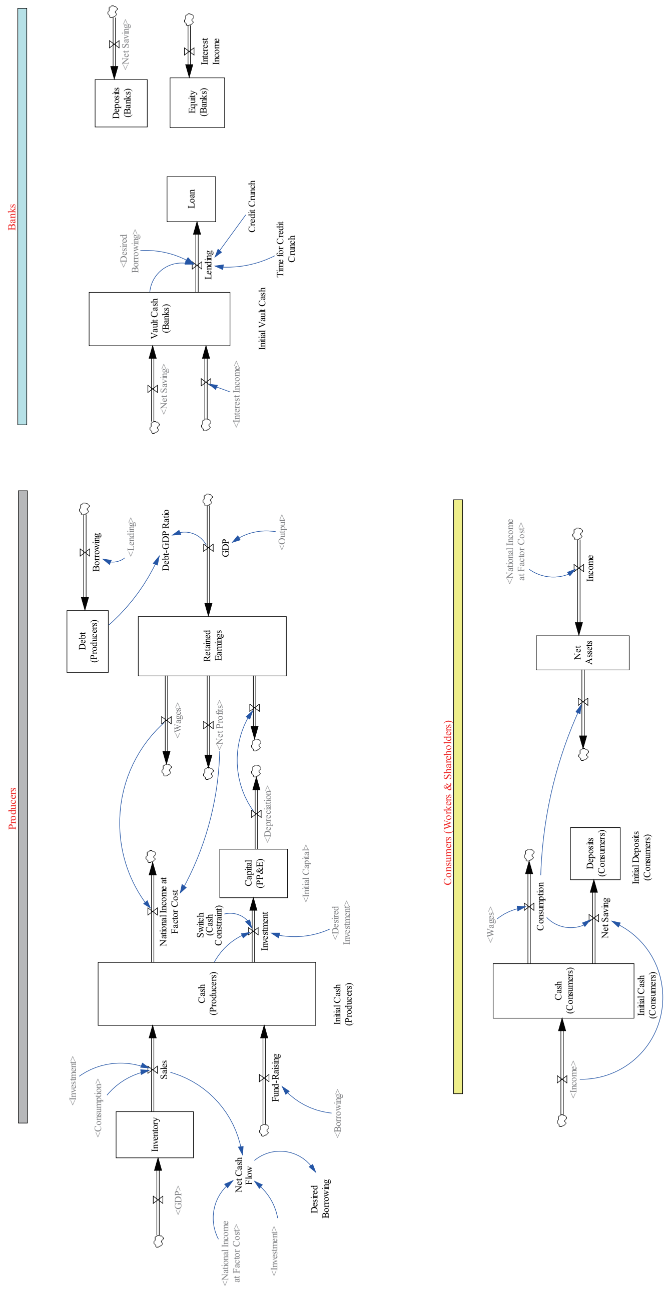

Figure 4.14: A Monetary Goodwin Model

have to keep investing the amount of 30. Surely, the source of this investment is provided by their savings and profits of 30. This is a macroeconomic level of steady-state condition. What will happen if some producers do not have enough cash for their investment at a microeconomic level of economic activities, or if they may be asked to pay their investment before receiving profits, because their products have to be sold out as consumption and investment before they realize profits?

In either case, to ascertain their investment, they must have at least the same amount of cash as their desired level of investment. What will happen if initial cash of producers is less than 30; say, 28 in our case of steady-state; that is, initial investment is reduced by 2 due to the shortage of money or liquidity? Surely, they are forced to raise additional fund by the amount of 2 as an initial desired borrowing. To our surprise, this small amount of cash constraint triggers business cycle as illustrated by Figure 4.15. In this way we

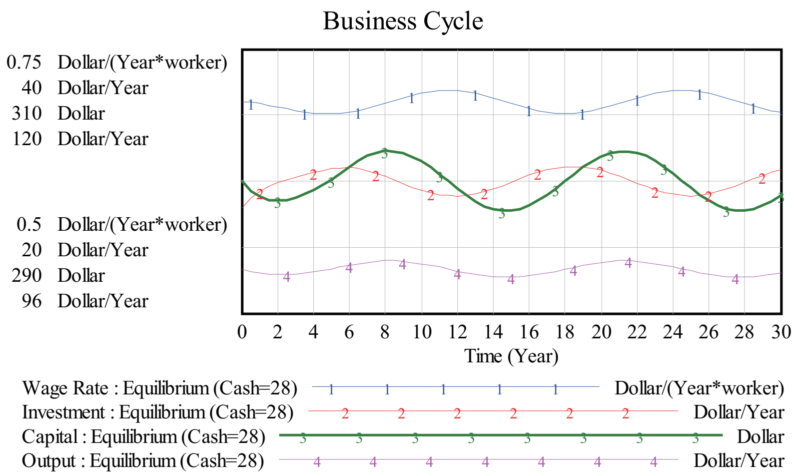

Figure 4.15: Business Cycle caused by A Monetary Constraint

have successfully identified the fourth condition that beaks down the steady-state equilibrium; that is, a monetary or cash constraint. Money is no longer neutral as neoclassical general equilibrium economists argue. It DOES indeed matter!

A Credit Crunch and Economic Recession

In the above business cycle triggered by the cash constraint, the first trough of investment cycle visits at the year 12 as line 2 in Figure 4.15 indicates. Now suppose that banks, being discouraged by the decline in investment, get worried about the economic prospect and constrain their bank lending by 30% of the desired borrowing amount by producers. In other words, banks caused credit crunch by 30% out of fear. This credit crunch is illustrated as a gap between desired borrowing (line 3) and actual lending (line 4) in Figure 4.16.

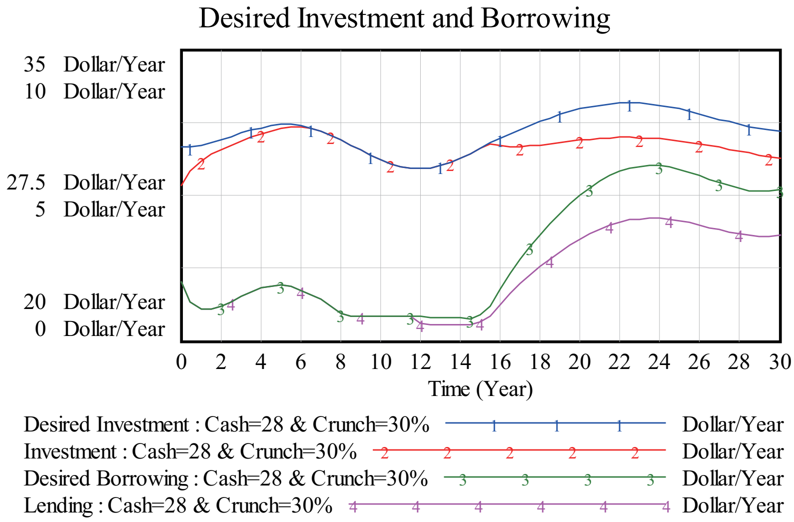

Figure 4.16: Desired Investment and Borrowing

Due to this lending restriction, producers can no longer borrow their desired amount for investment. This investment gap is illustrated as a gap between the desired investment (line 1) and actual investment (line 2). Credit crunch thus caused by the banks now affects output and employment as demonstrated by Figure 4.17. Line 2 in the left-hand diagram indicates the fluctuation of output

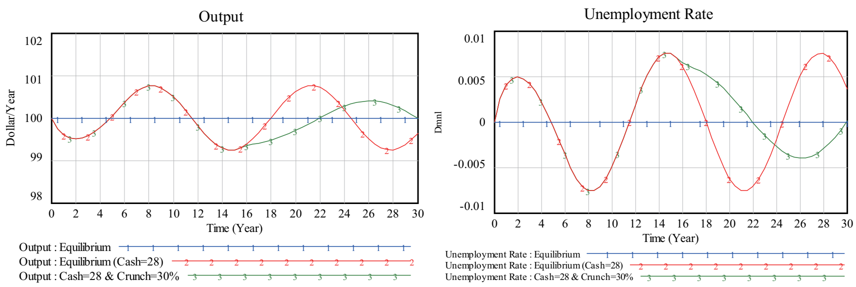

Figure 4.17: Output and Unemployment Rate caused by A Credit Crunch

caused by the initial cash constraint of 2, while line 3 reveals a prolonged output reduction cycle. Line 2 in the right-hand diagram indicates the fluctuation of unemployment caused by the initial cash constraint of 2, while line 3 reveals a prolonged higher unemployment rate caused by credit crunch. In this way, it is shown that a credit crunch not only breaks a symmetry behavior of business cycles but worsens the economic performance. In other words, it causes an economic recession!

To be worse for the producers, their debt continues to accumulate as Figure 4.18 demonstrates. Left-hand diagram shows the values of debt and the right-hand one shows Debt-GDP ratio, which indicates close to 30% of GDP. This is a monetary behavior which has been thoroughly neglected in the standard analysis of Goodwin model. Behind the well-discussed business cycles, a run-away accumulation of debt continues to grow. This debt accumulation may trigger another economic recession through the constraint of liquidity due to the increase in the interest payment as well as loan disbursement. To explore the possibility of this economic recession, the monetary Goodwin model further needs be revised with the introduction of interest, which will be done in Chapter 6 after we explore the nature of money in Chapter 5.

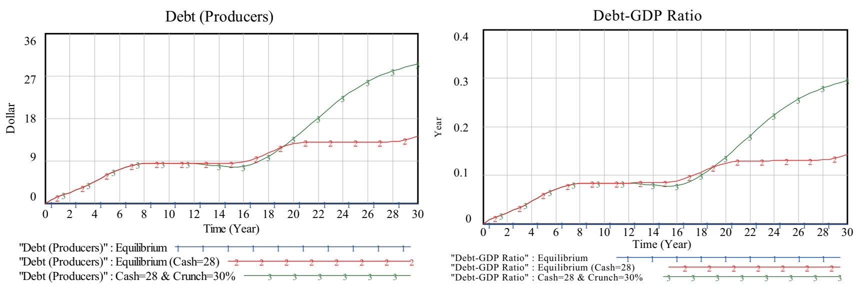

Figure 4.18: Accumulating Debt caused by A Business Cycle and Credit Crunch

Conclusion

We have over-viewed our macroeconomic system with an introduction of a simple capitalist market economy under the framework of accounting system dynamics method. Then, to analyze its economic behavior a Goodwin growth cycle model was introduced. Finally, those two models are integrated as a monetary Goodwin model. In addition to the standard analyses of Goodwin model, what was newly obtained from our analysis is that money matters to sustain a steady-state equilibrium. Moreover, a credit crunch by banks breaks down a symmetric business cycle and worsen it to the state of economic recession.

From this overview chapter, three important features are revealed to be missing.

(1) the reader may be convinced why our accounting system dynamics approach is essential to the analysis of economic behaviors. It's now time to move to the next chapter to consider what money is and where it does come from.

(2) Interest is entirely neglected from our analysis in this chapter, which will be covered following the next chapter on money.

(3) Goodwin model assumed a so-called Say's law. Actual output or GDP, however, is determined by the aggregate demand level as Keynesian macroeconomics proposes. To introduce the Keynesian determination of GDP, a Goodwin model has to be drastically revised. This will be challenged after the examination of money and interest rate in the next two chapters.