論　文

Macroeconomics of Hysteresis, Suddenness and Trap

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This paper does not assume the equilibrium configuration of demand and supply by immediate adjustment with rational expectations (or perfect foresight) and flexible prices. While many economists dislike economic analyses that do not depend on the concept of equilibrium, some, however, accept the assumption that markets do not necessarily clear. This paper follows this latter assumption. It is the purpose of this paper to characterize how a macro-economy operates when experiencing disequilibrium adjustments aided by agents whose abilities to predict are bounded; it is not the purpose of this paper to criticize the realistic validity of equilibrium models.

The real economy is a complex arena: many distortions attack this economy. It may or may not easily be influenced by various disturbances, like political and technological changes. Within this environment, economists feel it extremely difficult to describe its dynamics. Thus, they reach the conclusion that it is necessary beforehand to provide a deductive and firm static foundation in order to look at the real economy. Following this line of thought, the purification of the study of the economy naturally leans toward the neoclassical tradition. Nonetheless, this does not limit us not to discuss movements of the whole economy over periods of time. The observation of the dynamic movements of the whole economy still offers a valid economic science.

This paper presents a disequilibrium macroeconomic model in which dynamic economic adjustments of key real variables embody phenomena of slowness, suddenness, and persistency. It finds the ineffectiveness of expansion policy on a different basis from the RBC-typed theory. The inclusion of the analysis suggests that, in an economy falling into a trap of pessimistic outlooks, repeated insufficient monetary and fiscal measures may result in only a huge volume of government bonds in circulation and a creeping inflation, or sometimes in a state of stagflation. The

model developed in the present paper is available for the elucidation of what happened to the Japanese economy More generally, it is effective for shedding light on the characteristic sequential operation of the monetary economy[1)].

1－Demand and supply agents

A very basic or primitive example is used in the following discourse. An agricultural producer, or a farmer, can use his land freely. Suppose that the farmer is given his first set of crops. If he were to eat (consume) the entire amount this year, he will face starvation in the next year since he has not planted any this season and there would be none to harvest then. This means that the farmer becomes aware of the risk to his future existence (i.e., starvation) and therefore saves part of the crops as seeds for the planting season. The seeds are sowed and finally harvested: the farmer has produced an added value.

In the next cycle, a proportion is used as food and the rest is stored as seeds for the next planting season. This proportion is determined by the farmer's added value productivity and his time preference. If he does not have enough food, a larger portion of the harvest may be used for food than seeds. As the cycles continue, the farmer learns more about crop production. This learning process improves crop production without excessive deterioration placed on the land. Successful ventures result in increased consumption and investment. As the expanded production continues in succession so the farmer's welfare increases.

A surplus occurs when the amount produced in the succeeding expansions of production exceed the total amount of current consumption and seeds planted for the next harvest. The residual part that is neither consumed nor invested results in excess produce. If there were a third party who would be willing to receive (take) this residual, the surplus situation disappears. In return for this residual part, any third party may in exchange offer her own produce to the farmer, for example offering eggs and milk from her poultry house. The farmer may choose to expand his crop production as he takes into account the relative rate of exchanging and the

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1) The author shares Akerlof's understanding that Keynes (1936) blamed market failures on psychological propensities and irrationalities. According to him, Keynes' *General Theory* was the greatest contribution to behavioral economics. Economies, like lions, are so wild and dangerous that modern behavioral economics has rediscovered the wild side of macroeconomic behavior (Akerlof, 2002, p.428).

possible exchanges he can make for his surplus produce. Thus, economic transactions become so comprehensive as to establish an economy that utilizes money. This modern economy further leads to the development of an economy producing non-agricultural commodities, or manufactured goods, as the proportion of the economy devoted to agricultural produce declines. As the economy continues to develop, the importance of a financial sector that facilitates a market framework for present and future production of goods increases. This economic development story narrates the development of the exchange economy with which many students are already familiar.

Within the contemporary economy, the producing agent is generally not the same as the demanding agent and the investing agent is not the same as the saving agent. The advent of money makes this situation possible by acting as the exchange medium. Under the current money exchange economy, the producers (firms) determine the sets of goods to produce and the amount of this to supply based on their subjective market prospects. If firms fail to form correct anticipations, disequilibrium occurs between supply and demand, suggesting that economic adjustments also occur. Economic adjustments entail the development of issues with regard to economic efficiency of resource allocation and economic welfare.

2 - Aggregate supply and the general price

For firms facing a completely advanced production system, the anticipation of future demand is an essential component in order to stay in the market. A producer needs to determine how much to produce at a selling price determined by the subjective prediction of future demand given the state of technology. Confronting uncertainty in the enterprise of production is the principal characteristic of entrepreneurship; the ability and attitude to face uncertainty is the subsistence of entrepreneurship. In the meaningful and profitable prediction of the uncertain future, entrepreneurs may be guided by past experience relying on *a priori* theories. Furthermore, *ex ante* anticipations are not generally perfect yet firms make managerial decisions toward the future despite fearing that anticipations may be irrational. Given the existing level of technology and the capital stock, firms determine the present amounts of flows while at the same time determining the future level of stocks concurrent with future anticipations.

After the decision is made to produce, the firm needs a certain amount of time to have the actual products out in the markets. The volume of the future sales of a

product is at best a calculated guess: the estimation will be influenced largely by the current state of market demand for the same kind of products and its substitutes. If sales are doing well, firms will have bullish outlooks. Generally, firms recognize that high product prices reduce demand. Furthermore, firms adjust their output volume by the amount of unsold inventory[2)].

Because a firm is not a price taker, the firm necessarily sets the price level of its goods in relation to its production and managerial plans. In setting prices, the firm commonly calculates unit variable costs (variable wage costs and payments for raw and intermediate goods) given the current estimated operating conditions of plant and equipment while factoring in financial costs, business risks and market competitiveness. As a price-maker, it adopts the mark-up principle of full costs, where net profit margin is added to calculated unit variable costs. This mark-up rate is affected by the firm's own competitiveness and industrial market structure.

It is assumed that unit variable costs do not increase unless demand exceeds supply; at any operating level below a desired rate, production enlargements hardly generate direct increases in price. When the actual sale of goods exceeds the predicted level, the firm makes bullish price-settings for products fully considering the price elasticity of demand. If production is done at a level over the desired operation rate due to increased demand, there is an upward pressure on the price. If the quantity level of demand exceeds the latent supplying capacity, the price of finished goods will increase in large increments (S1.3).

Rising financial costs due to increases in the market interest rate puts upward pressure on product prices. Universal increases in input factor prices, such as wages, directly raise unit variable costs and easily affect the price of finished goods. On the other hand, an optimistic growth outlook for the whole economy reduces the riskiness of any business undertaking. A high level of real money and asset balances is associated with a high ability to finance that can materially reduce financial costs and enable lower price-settings (S1.2). It is a different issue as to whether those price

2) In order to grasp the image of the economy to be discussed, it may be useful to present a set of aggregate functional relationships explicitly. In the first place, we can contrive a macro behavioral function as shown in the Appendix, equation (S1.1) for the subjective aggregate demand function. Hereinafter, there will emerge a number of parentheses designating particular equation number, like (S1.2) for the price equation in the text, each of which similarly presents the macro relationship in question.

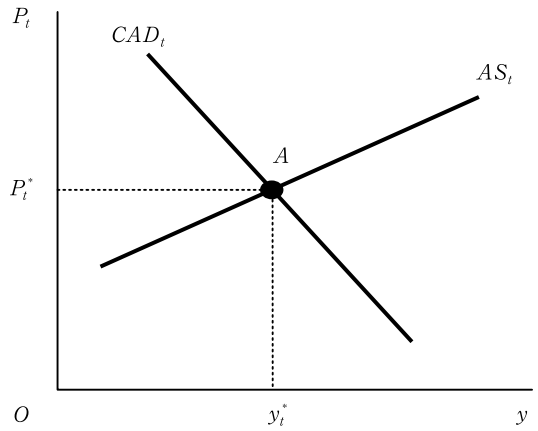

Figure 2. 1. ***The Selected Combination of Aggregate Output and the General Price***

changes can be consistent with a set of price vectors that generate the market clearing. Thus, at the aggregate level, there is no guarantee that the whole economy necessarily operates in a state of general equilibrium.

Thus, the macro determination of output (y_t) and price (P_t) at period t can be shown in the following diagram (Figure 2.1). The AS_1 and CAD_1 curves respectively represents the aggregate supply curve and the conjectural aggregate demand curve for period t. The macro determination, point A, corresponds to the condition that y and P satisfy both the AS and CAD functions.

3 - Technology and potential capacity

When demand exceeds supply, the former is rationed by the latter. Suppose however that there is a demand for 110 houses but there are only 100 houses for sale priced at 30 million yen[3]. In the event of zero house inventories, the demand for 10 houses is not satisfied[4]. If it were expected that housing demand in the next year increase further to 150, housing supply reasonably increases. However, if the current physical capacity of supply is limited to only 130, the maximum number of actual supply is inevitably 130. Demand is accordingly restricted by capacity. In the midst of economic developments, an economy may face a limit to growth generated by a

3) These started to be constructed in the last year and are now available.

4) In this case, an excess demand for 10 houses exists in the present period. This event necessarily affects the prices of new houses just about to be built and to be sold in the next period. However, the current prices are rigidly observed for the present period.

shortage of a specific factor of production and/or technology. It is to be expected therefore that economists primordially discuss on the supply-side, which stipulates potential growth power.

Any firm needs to have a certain level of production facility to supply goods to markets, and accordingly employs a set of labor, capital stock, and land (physical factors of production) procured at the respective prices. The firm's potential capacity for production is associated with the full utilization of existing inputs (S2.12). If any firm behaves rationally and perfectly predicts demand for its products, supply is necessarily equilibrated to demand and production facilities are utilized at full level.

This technology referred to above is related to the combination of factors of production that a firm employs. Suppose there is a given set of capital stock, labor, and technology. Given a state of technology, workers are divided into skilled and ordinary workers; the former are complementary to capital stock while the latter are replaceable with capital stock (S2.6). Capital technology refers to the combination of capital and complementary labor inputs (S.2.8). There is a given ratio between the quantities of capital and skilled labor. For a firm, it is useful to secure skilled labor. Skilled workers can be substituted for ordinary workers but the reverse is not true. If a skilled worker cannot be employed at the skill level he is trained for, he can be employed as an ordinary worker if he accepts lower wages. In such an economy, ordinary workers are more exposed to business fluctuations than their skilled counterparts; consequently, their unemployment rate is higher (S2.18 and 20).

As the firm expands production, it becomes necessary to procure additional plant and equipment; it is also often the case that recently bought machineries are new technologies that necessitate complementary labor input. Since firms are rational agents, although acting with imperfect information, the decision on the capital equipment is predicated on the existing situation (e.g., availability of complementary inputs) as well as the predicted future (i.e., firm's future anticipation). When complementary labor is inadequate, the firm may have to implement additional training programs for ordinary workers; however, if such a plan is predicted to have little success the firm will match the level of technology to be acquired. Accordingly, serious output constraints as caused by the lack of complementary labor generally do not occur. Besides, under a given state of technology and capital stock, the amount of labor is always enough for production in the long run. If the extreme case of labor shortage were to occur, the employment of labor-augmenting or labor-saving

capital technology might mitigate this shortage.

Labor shortages occur in specific industries or as short-run phenomena. For example, in post-war Japan, in order to realize the goal of industrial modernization, many people received mandatory job training. Potential laborers from the agricultural sector and the peripheral labor segments, or the latent unemployed such as women, swelled the ranks of the national labor force. In comparison, the United States implemented a national immigration policy to complement and secure the necessary labor force; in some leading industries, plants and factories were also relocated. It is worthwhile to note that the respective growths of both Japan and the United States depended on the sizes of capital and levels of technology; in other words, the economic growth relied on total productivity growth rather than on the mere volume of the labor force.

The ratio of skilled workers to the total number of workers in any concerned economy is already determined and given; the number of ordinary workers follows this ratio (S2.3). There is no guarantee that a skilled worker in the present is able to remain as a skilled worker in the future. He faces obsolescence from the challenges of new entrants. However, on the whole, the ratio of skilled workers is kept unchanged. The labor efficiency[5] of a skilled worker is higher than that of an ordinary worker: a skilled worker's efficiency exceeds an ordinary worker's even if he takes the latter's job (S2.4 and 5).

The diligence of a worker depends on the real wages paid to him. When high wages are paid, the worker acts honestly and shows loyalty to his employer. As a result, the level of wages in the whole economy is pushed up. High level of wages produces involuntary unemployment: there would be some workers who cannot find a job at the current wage level. The probability of unemployment is an identical probability event among individuals belonging to the same workers group, and as such, unemployment becomes a threat for workers. The probability depends on technology, labor's view on working, and other factors, including unemployment insurance within the concerned economy[6].

Generally, as a buffer for possible changes in demand, the capacity equipment

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5) It is convenient to use an efficiency unit for measuring the amount of labor spent on production.

6) There has already been a wide variety of literature on efficiency wage hypotheses. Okamura (2001) used an efficiency relative wage model in these discussions.

invested in is on a larger scale than the current demand levels. The potential loss accruing to firms from the unused capacity is smaller than the potential loss accruing from being unable to respond to fluctuations in demand (i.e., losing customers). Thus, the optimal operating level a firm sets is a little below 100%. Needless to say, existing factors of production will be underutilized in the event the expected actual demand is lower than the optimal operating level (S2.16). Machines and facilities are unused and there also occurs additional cyclical unemployment, which exceeds the long-run level of involuntary unemployment under the efficiency wages setting (S2.17 –20). In many observed cases among advanced capitalist countries, including Japan, many produce below the potential levels for long lengths of time. Any economy will deviate from its potential capacity more and more if demand continues to contract.

4 – Aggregate demand

The size of consumption expenditures, including consumption on durable goods, depends mainly on the willingness of households to consume, the levels of present and future earnings, and the scales of present and future financial ability. When financial or highly liquid assets are increased in proportion not only to the current income level but also to permanent and future income levels, the increased abilities to spend and to finance increase consumption. An incremental increase may also come from an easy money banking system that aids consumers to adjust consumption. The motivation for consumption does not merely rely on the autonomous changes in the consumers' utility functions; it is also affected by firm behavior in the supply-side. This is evident in the modern society where new products give rise to new consumption. Of course, the growth of population pushes up aggregate consumption as well (S3.6).

Firms always try to operate its plant and equipment at the optimum level because they will always have profit incentives. As firms need considerable time to complete the installation of new plant and equipment, the expected optimum level will be related to the size of expected product sales at the time of the complete capital establishment. The firm must add capital equipment should existing capacity levels become small in comparison to actual demand and consequently will decide to build with potential excess capacity level. The greater serves for the lesser. A new investment project, under which new capital goods are purchased and installed, necessarily forms an earning forecast for durable periods for the newly invested plant and equipment. The amount of investment increases if a high earnings forecast is

provided; conversely, the willingness to invest declines if a rise in the interest rate is anticipated in the long run. Furthermore, in comparison to consumption expenditure, investment will also expand if funds procurement becomes easier. Also, a population expansion is positively associated with investment opportunities. However, an accumulation of capital stocks may decrease opportunities for investment, other things being equal (S3.7).

Government and foreign demand are other important components of aggregate demand. Foreign economic environments such as industrial structures and terms of trade determine exports (S3.9). Exports are the collection of demand emanating from foreign countries. Government demand is divided into structural and discretional parts. While the contemporary government relaxes monetary and fiscal spending (interest lowering and quantitative easing policies) in a recession, it takes the reverse countermeasures during a boom. Indeed, it functions like a rule more or less in any economy, no matter how Keynesian its chief advisory members may be. The scale and the combination of those measures depend on the nation's economic structure, including the exchange rate and the social state of expectations, in addition to the issues the economy faces.

Thus, the size of aggregate demand is the sum total of consumption, investment and government expenditures, and net exports. In the present economy, this volume of aggregate demand does not necessarily always agree with actual quantity supplied. Generally aggregate demand falls short of meeting aggregate supply. When the economy needs one time period to complete the planned production, excess supply in

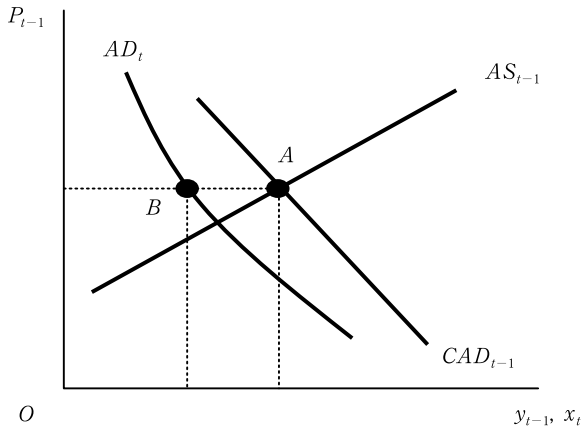

Figure 4. 1. ***Realized Excess Supply in Period t***

period t can be given by a difference between the aggregate supply scheduled in period $t-1$, $y_{t-1}(P_{t-1})$, and the actual volume of aggregate demand in period t, $x_t(P_{t-1})$.

5 - Expectations and real interaction

Calculations of future returns and cash flows are central to the formation of expectations. If the present and future social economic structures are self-evident for an agent, he faces a dynamic problem subject to his own rational objectives in the present. The failure to do so is an exceptional case occurring as random events. Barring such a situation, the agent is freed from true uncertainty since he has certain knowledge about the future. However, the rationality of an agent is bounded such that the information available on the future is imperfect and the ability to predict accurately is limited by this.

Any rational economic agent is inherently driven to perform toward an uncertain future. For instance, in order to outperform competitors firms prepare detailed planning and design new technologies; and the "adventure-spirit" in confronting the uncertainties of the market is what drives firms toward better performance not only in the present but also in the attempt to predict the future accurately. Goal setting and the ability to predict are two activities that are closely related since goals must be rational objectives. Ignoring this, goals become merely dreams. These goals, or future expectations, address the agent's expectations of the future.

Economies are provoked by economic fundamentals, unreliable speculations, and not to mention, political disturbances. In the same way as the fundamentals of the economy has a structure, the state of speculation also has an internal structure. The structure of expectations is related to past and present structures of fundamentals, including speculation, adventure, and even animal spirits. Fundamentals are interactively affected by this expectation structure. Expectations are formed by the realized present, past, and theoretical inferences, but those expectations have an influence on human behaviors and control their future. Expectations are then self-fulfilling in this sense.

There are many economic variables to consider in order to predict the future. Firms and households want to know future values of returns, costs, earnings, general prices and so on. However, the most comprehensive and basic expectations variable that represents the entire economy is the business outlook for the future economy.

Expected earnings rate and present values are all influenced by the expectation of how the future business state will perform. Expectations are not exogenous to an economy: the economy forms expectations about itself on its own. Future expectations have retrospective effects since the agent's current decisions are conditioned by expectations of the future.

The state of the whole economy's business outlooks is represented by the long-term real rate of economic growth that the society holds, ρ (S5.1 or 5.2). Although many economic variables depend on the state of business outlooks, the latter moves with fluctuations in endogenous variables within the system and with exogenous variables[7]. A high level of ρ, which means high-expected rates of profit and earnings, creates a considerable portion of aggregate demand by stimulating consumption and investment expenditures (S3.6 and 3.7). It relaxes the possibility of business bankruptcy by default, reduces supply costs, and shifts the aggregate supply to the right (S1.2)[8].

6 - Formation of social expectations

A society may be divided into opinion leaders and followers. The public opinion follower is not forced to obey any decision made by the leader but follows the leader's decisions voluntarily. One imitating the other does not necessarily imply abandonment or negligence of rationality for it is reasonable to follow the leader's trustworthy signals and judgments, and the follower can save on decision-making costs. If the leader makes the announcement of a sudden and extraordinary signal to the follower, the follower may carefully consider it then choose to follow or discard the information.

The opinion leaders group prospects the future positively. The leader sets a goal that may include personal objectives. The leader group must have necessarily

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7) Since the state of expectations is a conceptual variable, it is necessarily represented by actual money variables or real variables. However, economists used to assume that the state of expectations is given exogenously if it is seen as too difficult to make an endogenous explanation of expectations formation. It is possible then that there are no expectation variables in many economic models.

8) When considering the macroeconomic state of expectations for an economic model, we incorporate the expected rate of economic growth as an explanatory variable into behavioral functions. The sizes of the expected rate of earnings and present value at the micro level can be reflected by the expected rate of growth at the macro level.

formed positive future anticipations rationally in order to convince the followers. This predicting agent collects and analyzes present and past examples; in collecting every kind of information, including theories, and predicting growth rates, he revises these anticipations continually as information flows. However, the interactions between actual and expected values vary according to bearish or bullish psychological states. The change from a bullish state to a bearish state and vice versa is not a simple transition; during the transition from one state to another, the predicting agent would experience a lingering attachment to the former state or some psychological sway. This situation is characterized by the coexistence of bullishness and bearishness that corresponds to a fragile structure of expectations, which is easily influenced by disturbances.

It is very difficult to ascertain growth rate for long periods of time. It is brought upon an agent, however, to make decisions in the present period, committing to an expected (derived) view of a future state. The expectations in themselves are inherently unstable if he fails to have a highly accurate expectations formation method. Although he learns from examples and theories, he cannot remove the possibility of his swaying in the psychology between bullishness and bearishness since it is generally difficult to make expectations of the future rationally.

The long-run record of the past is an influential guide on the future. If a high economic growth rate continued for several periods in the past, predictions of the future may simply follow this line. Further, previous high growth achievements can cast a shadow on subsequent growth expectations. However, faced with the same actual values of flows, the content of expectations varies according to different levels of stock accumulation. As a result of long economic growth, financial assets, durable consumer goods, plant and equipment, public capital stocks are increased. At the same time, credit expands. Increases in financial assets and credits generate corresponding increases in consumption and investment. If a feeling of saturation is born in markets by the accumulation of capital stocks and the spread of durable consumer goods, the agent no longer expects the same growth rate in aggregate demand like the past. There might also be limitations in the successive introduction of new capital technologies. Swelled credit, in reaction, leads to expectations of shrinking credit. Furthermore, high growth cannot be expected if non-renewable resources, like the environment, have been depleted or damaged. An invented accumulation of asset stocks stemming from growth influences the psychology of the

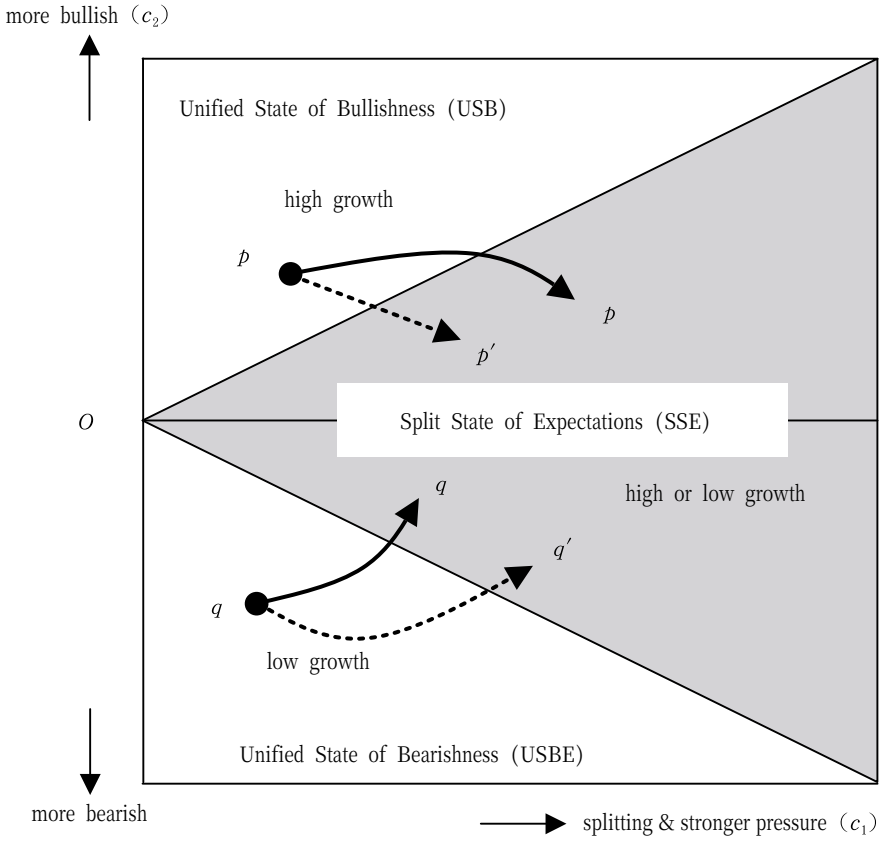

Figure 6. 1. ***Structure of Expectations of the Opinion Leaders Group***

predicting agents to sway between bearishness and bullishness regarding future business outlooks (S4.3-7).

Figure 6.1 illustrates the structure of expectations which the opinion leaders group holds. A high growth supported by a firm bearish mind goes to a decelerating growth in the swaying state of psychology after all: for example, the path pp or pp' showing a movement from the region USB to the SSE. If the government executes a shift in monetary and fiscal policy to restrain the high growth, the predicting agent, swaying between bearishness and bullishness, drastically reduce the expected growth rate at a certain point of time while still clinging to the past growth. Indeed, in the case of excessive high growth, budget deficit, inflation, and credit expansion, suppressive monetary and fiscal policies are employed to smooth out business movements. This event corresponds to a moving path, from the region USB

to the region SSE and finally USBE[9]. There occurs a sudden negative-jump during the transition from SSE to USBE.

Suppose there is an economy which has had decelerating growth (negative growth) continuously during the past periods. It is safe to predict that a similar tendency continues for short- and long-term future periods. However, bullish outlooks will come if stocks are lost enough and the relative price adjustment becomes complete. Meanwhile, there may arise among predicting agents anticipations of turning away from chronic economic depression. If signs of a recovery are seen in actual economic indices, an upward movement in the expectations structure commences even though it is fairly small at first (the path qq or qq'). When it is accompanied by a discretional stimulus, it is possible that the state of expectations suddenly shifts to bullishness. Such a scenario includes a transition from the region SSE to USB as continue of movement along the path qq or qq'.

The expectations about the real economic growth rate that the optimistic predicting agent forms are conveyed to the rest of the agents via market signals in various actual transactions and via the information media. The social long-term real rate of economic growth is formed as followers continuously revise expectations as led by the opinion leaders (S5.1). The follower does not blindly follow the leader but may persist with customary practice. The follower evaluates ensuing extreme signal changes while at the same time watching the entire trend of expectations on economic growth. When the number of people who believe in the leader increases in number the dispersion of the leader's signal accelerates (S5.2). After a big change in the leader's expectations has occurred, there follows a big change in the expectations of the whole society, ρ, following a time lag.

Thus, the disequilibrium of flows precedes stock adjustments and the disequilibrium of stocks precedes fluctuations in flow variables, both of which are affected by changes in exogenous factors. Economic variables sometimes fluctuate continuously and other times discontinuously. The GDP, employment rate, and growth rate occasionally change suddenly and largely. Of course, a sudden change in endogenous variables can be explained by a sudden change in an exogenous variable. However, except in the case of a great event such as a revolution or a meteor collision to Earth, it is difficult to force any person who sticks to a past customary practice

9) There would occur a leftward shift, i.e., a decrease in A_0, in Eq. S4.3.

and lives in inertia to change his attitude drastically and suddenly. In many cases where big changes in the state of expectations have been observed, the actual level of employment, and other micro- and macroeconomic variables, it would be fair to see that the mechanism breeding those changes is built in the economic structure of the society itself.

7 – Cyclical movements of an economy

How does the preceding illustrated economy operate in general? If we were to begin with the situation where the economy grows smoothly subject to a certain set of exogenous growth rates of the population, money supply, and aggregate demand component, can the economy follow its stable growth path forever?

If economic growth continues without any interruption, the predicting leader may have a big expectational jump from the state of bearishness to that of bullishness, so society can be led to believe in future high growth. Accordingly, the economy may encounter a sudden big change toward a much higher growth. Meanwhile, a considerable stock of total assets accumulates in the economy. While the accumulation may lead to positive asset, development, and output effects on demand and supply, it certainly has suppressing effects on consumption and investment demands due to a generalization of physical saturation. Besides, a high economic growth operation is often accompanied with negative externalities. The psychology of growth limitations is born in the society when people's life space includes distortions of economic growth (income differential, inflation and public hazards). Under a given state of taste and technology, if society has a feeling of saturation and notices the costs of economic growth, there appears a decreasing phenomenon in the desired growth rate. This possibly influences the predicting agent to incorporate a slowdown in the expected future growth.

The appearance of an actual diminishing growth and growth limit psychology eventually splits the expectations on the future growth rate. Unless an appropriate anti-cyclical stimulating measure is employed, the economy continuously slows down, and possibly intercepts an upward recovery of the expected growth rate. The formation and correction of expectations is done slowly through certain socio-economic relations among the people. Even in the absence of an additional dramatic shock to the economy, it is possible that expected growth rates by the opinion leader and by the whole society might change suddenly and largely. Remind that we often

execute discretional interventions or normally have some policy rule. A squeeze on aggregate demand may occur in an economy mistakenly judged to be overheated, particularly when the economy is already characterized by the split state of expectations. Such negative disturbances (i.e., governmental monetary and fiscal restraints) amplify and accelerate a sudden recession within a society whose growth outlooks are already diminishing.

The actual rate of growth falls to a negative level or falls by a large amount corresponding to a catastrophic change in ρ. What follows is a decrease in assets, for instance at least, the level of physical capital stock. This significant drop in aggregate demand increases the upward tendency of unemployment rate. A bearish depressed mood settles on the society as social growth outlooks are pushed down suddenly. It is possible that the economy may enter into a negative bubble state accompanied by deflation[10]. Figure 7.1 may help an easy grasp of such a scenario[11].

Suppose that such a depressed economy would execute financial and fiscal expansion policies to recover. However, if these policies fail to have any significant effect on both actual aggregate supply and demand, the economy would fall into a deeper trap of pessimistic outlooks. Because governmental expansion policies necessarily aggravate its financial condition while they increase the level of total asset stocks (S6 and Figure S6.1-2).

Recovery is not easy for any economy that has been colored by pessimism: the closest example would be the recent Japanese economy. After the asset bubble collapse, while undergoing additional negative disturbances, the Japanese economy fell into a deep trap of a depression despite repeated fiscal policy instruments. Although inflationary prices had not prevailed, the consumer price index recorded a negative

10) Market participants sometimes believe that the price of any asset is likely to rise, and then purchase expecting to be able to resell at a higher price. Many economists including Keynes (1936, Chap. 12) have suspected that speculation could lead to bubbles. A positive bubble state may be born of a transition from the SSE to the USB necessarily with a sudden relatively big upward-jump; it coincides the spreading of bullishness over the society (S5.2). The bubble economy would begin to collapse at the point in time when the spreading process is completed. On the other hand, a negative bubble may occur on the way to the state in which all agents become bearish taking a sudden downward change in the expected growth rate that the leaders group holds. The term "bubble" is associated, as it were, with the social structure of expectations in this analysis.

11) For characteristic phases of the dynamic operation of a simplified economy disturbed by negative or/and positive shocks, see case (1) of the simulation example in the Appendix.

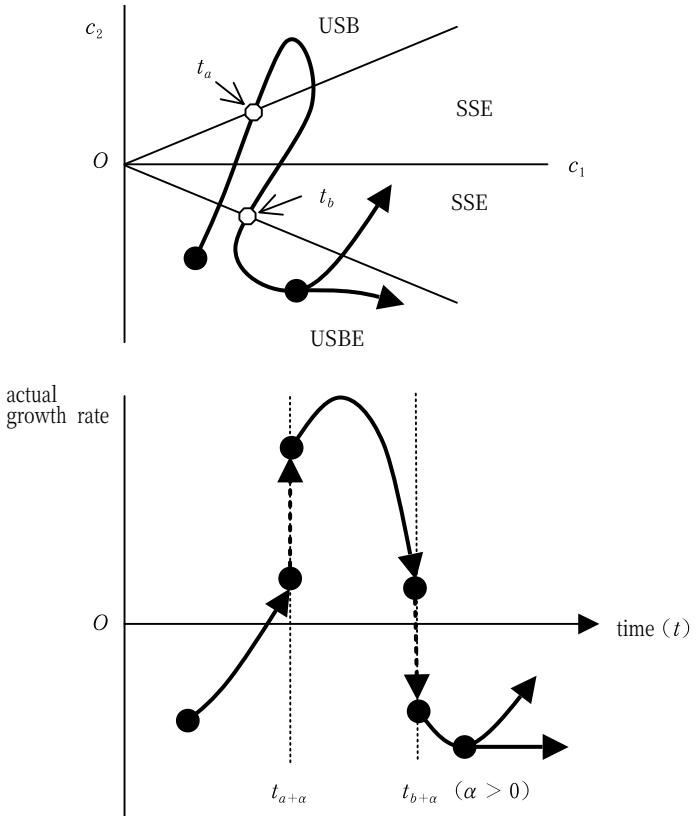

Figure 7. 1. ***Sudden Changes in Expectations and the Actual Growth Rate of Aggregate Supply***

rate—its first since 1958. In other words, deflation occurred in the Japanese economy. Further, the unemployment rate rose, and the GDP (or GDI) percentage of net assets (total assets minus debts) fell. Overborrowing became an issue since real debt swelled with a fall in the price level (debt deflation) and asset prices fell (asset deflation). Though stock accumulation generally becomes a buffer for these types of disturbances, the accumulation of non-performing loans undermines the whole economy since it causes the flow activities to be lower under the deflationary environment. An increase in the cumulative budget deficit has also been one of the sources that has affected and will continue to affect the future of the Japanese economy.

Under a bearish economic outlook, consumption and investment were too sluggish in the Japanese economy. Market transactions were done under a unified-likely state of bearish prospects and deflation (Figure 7.2). While effects of price decreases and anti-cyclical stimuli faded in a situation in which people's willingness

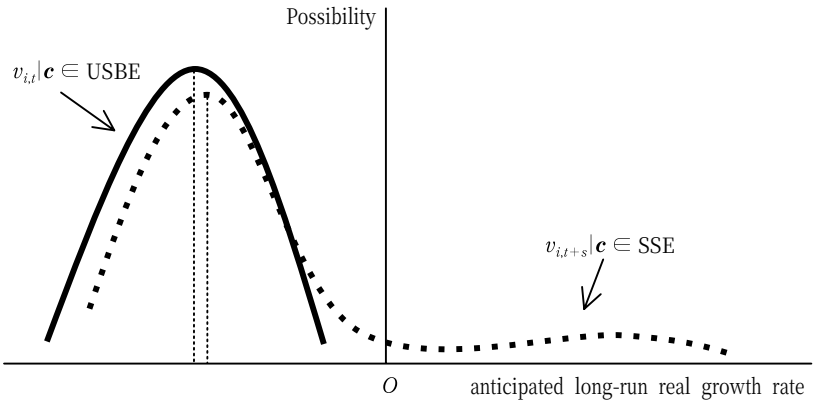

Figure 7. 2. ***Strongly Bearish Expected Growth Rate***

and ability to transact declined, an added negative shock's ability to promote instability was magnified by adding in the unemployment issue. Many foreign economists continued to express a dismal outlook in evaluating the Japanese economy, emphasizing frequently the crisis within it. However, merely finding inherent heterogeneities with the Japanese economic structure was not their main challenges. It is because these economists acknowledged the possibility that the same crisis event could occur to their economies sometime in future.

However, there is a recovery scenario from the depressed state wherein the actual growth rate is low enough and the state of future growth prospects is dismal. A continued economic slump invents an earnest desire to economic growth, decreasing the stock of assets. The relative price adjustments and restructurings throughout the depression affect a splitting phenomenon of bullishness and bearishness in the opinion leader's mind that has been engulfed in a unified timidity. When the expected growth rate begins to rise, a business stimulating measure clearly influences an upward tendency in the economy. If an actual continuous growth of the GDP encourages the opinion leader out of his anxiety toward a bullish mind and a positive outlook for a stable high growth rate in the future, there appears a big upward-jump wherein the whole economy shifts to a strongly bullish position at last. If both the opinion leader and the follower become firmly bullish, unless there is any constraint of supply, the high growth rate of flow and the accumulation of asset stocks are both realized at the same time. When an actual economy enters a firmly optimistic economy with bullish growth outlooks, it possibly enters into another bubble economy.

It is feared that the current Japanese economy is still straying from the preceding recovery scenario illustrated. Indeed, "the lost decade" view has been extended over the Japanese society. However, very recently (at least early 2004), the economy is showing signs of a recovery while advancing its own restructurings. In this regard, it is possible that the expectations structure of the economy has already entered into the region SSE, the split state. Only, it is not certain whether a higher growth under the more optimistic state of expectations could be restored to the Japanese economy[12].

Conclusion

The demand and the supply for products are determined by different sets of individuals in the monetary economy. The sizes of both aggregate demand and supply reflect the expectations structure of the economy, which is affected by aggregate economic activities throughout time periods. Although producers try to make the best rational plans for supply, there remains a gap between the actual quantity supplied and the actual quantity demanded in the future period. Generally aggregate demand falls short of meeting aggregate supply. Realized output is less than the potential capacity level. One or all the factors of production become unemployed or unused.

Ultimately exogenous variables are unavoidably left. It remains necessary, however, to be able to account for the endogenous fluctuations in the representative expectations variable that reflect future overall business outlook. Social economic agents may be grouped into the opinion leaders group and the followers group. The former positively forms economic outlooks. There are three phases that characterize the leaders' future expectations: (1) unified bullishness, (2) unified bearishness, and (3) the coexistence of bullishness and bearishness. It is possible for either a unified bullishness or a unified bearishness to occur suddenly after the mixed state.

Facing the leaders group's sudden big changes of expectations, the followers do not respond quickly to those changes. The time lag allows the followers to achieve full acceptance. However, once they entirely follow the leaders group's predictive judge, the entire social expectations structure alters greatly. This corresponding change in the long-term expectations growth results in big changes in economic

12) We are concerned here about negative effects, including increases in oil prices caused by the Iraqi War (March, 2003).

variables such as the volume of the GDP and employment.

In an economy falling into a trap of pessimistic outlooks, repeated insufficient monetary and fiscal measures may result in only a huge volume of government bonds in circulation and a creeping inflation, or sometimes in a state of stagflation. Only by correctly identifying the sources of the slump, the economy can choose an appropriate combination and content of fiscal, monetary, and structural policy measures. Without any reassuring recovery signs of the real economy, accompanying policy changes with increases in present and future individual burdens would create an indispensable delay in the economic recovery, and at worst may cause a deterioration of the present situation.

The Japanese economy has had a long time to develop an economic structure of high growth as well as that of a low or even a negative growth. In between, the economy has had experience of both sudden upward and downward jumps. The present Japanese economy may be still in a unified bearish state. There should have been a need for a mixed package of more dramatic anti-cyclical stimuli and more deliberative structural reforms aiming to promote a speedy upward movement and an upward-jump. Yet, we recognize that the time it would take for it to take into effect would be considerable in our social economy.

(July 2004)

Appendix: Numerical simulation

I have just presented my own comprehension of the actual monetary economy. This appendix supplements the preceding analysis with numerical simulations using a hypothetical set of macro-behavioral equations that reflect the arguments in the text.

S1. Determination of output and price

For simplicity, suppose the linear *CAD* function :

$$\text{(S1.1)} \qquad y_t = -0.2P_t + s_2\rho_{t-1} + 40\left(\frac{x_1}{y_{t-1}} - \chi\right) + 1.9x_t - 0.9y_{t-1} + 100, \quad y_t \leq y_{f,t},$$

$$s_2 = 1,\ \chi = 0.95,\ y_{t-1} = 600 \text{ (initial value)},$$

where y is output, x is aggregate demand, P is the general price, χ is a normal

demand-output ratio $(0 < \chi \leq 1)$, and y_f is the level of potential output. The subscript t denotes time periods.

The price equation (i.e., AS) is given by

$$(S1.2) \quad P_t = \pi_0 UC_{p,t} + 0.01 y_t + 1 \cdot 10^{-4}(x_t - y_{t-1}) - 0.022\left(\varphi - \frac{y_t}{y_{f,t}}\right)$$
$$- 1.5 \cdot 10^{-3}\rho_{t-1} - 2 \cdot 10^{-4}\left(\frac{M_t}{P_{t-1}}\right) - 1 \cdot 10^{-5}\omega_{t-1} + 0.08 i_{M,t}, \quad \pi_0 = 1,\ \varphi = 0.995,$$

initial values; $UC_{p,t} = 9$ (constant), $\rho_{t-1} = -2.8982$, $P_{t-1} = 9.8$, $\omega_{t-1} = 2 \cdot 10^3$,

where UC_P is unit variable cost, φ is a desired operation rate $(0 < \varphi \leq 1)$, ρ is the expected long-term real rate of economic growth the society holds, M is nominal money supply, ω is the balance of real assets, and i_M is the market interest rate. However, if aggregate demand exceeds the level of potential output, i.e., $x_t \geq y_{f,t-1}$, then $P_t = P_{t-1} \exp\{\overline{\pi}(x_t - y_{f,t-1})\}$ $(\overline{\pi} > 0)$.

S2. Technology and employment

S2-1 Macro production function

It is assumed that the working population $\tilde{N}$ grows by $100\tilde{n}_N$ % exogenously from an initial value N_0:

$$(S2.1) \quad \tilde{N}_t = N_0 \exp(\tilde{n}_N t), \quad N_0 = 340,\ \tilde{n}_N = 0.01$$

The workers are divided into two groups: skilled and unskilled (or ordinary) workers. The percentage of skilled workers to the whole working population is $100\phi_g$ %, which we assume to be comparatively stable. Then,

$$(S2.2) \quad \tilde{N}_{g,t} \equiv \phi_g \tilde{N}_t, \quad \phi_g = 0.24,$$

Hence, the number of unskilled workers is given by

$$(S2.3) \quad \tilde{N}_{L,t} \equiv (1 - \phi_g)\tilde{N}_t, \quad 0 < \phi_g < 1.$$

The potential labor force measured in terms of labor efficiency units under the efficiency wage settings is shown by

$$(S2.4) \quad N_{g,t} = e(w_g)\tilde{N}_{g,t} = \tilde{N}_{g,t}, \quad e(w_g) = 1,$$

and

(S2.5) $N_{L,t} = e(w_L)\tilde{N}_{L,t} = \beta\tilde{N}_{L,t}, \quad \beta = 0.86 \ (0 < \beta < 1)$

The real wage for skilled workers w_g is set at a higher level than that for unskilled workers w_L [13].

The macro production function is

(S2.6) $Y_{f,t} = T_t(Z_{K,t-1})^{\kappa_1}(N_{L,t})^{\kappa_2}, \quad T_t > 0, \ \kappa_1 = 0.54, \ \kappa_2 = 0.36,$

where Z_K, N_L, and T respectively stand for capital-technology, ordinary labor with no special skills training, and total factor productivity. The assumption for simplicity needs only two explicit factor inputs, Z_K and N_L. N_L is substitutable for physical capital. The capital-technology Z_K is an input variable of the technical complementary relationship between skilled labor N_g and physical capital K. Since skilled labor is a complement of physical capital,

(S2.7) $Z_{k,t} = \min[a_K K_t, \ b_K N_{g,t}], \quad a_K > 0, \ b_K > 0.$

However, as the lack of complementary skilled labor does not occur, equation (S2.7) can be simplified into a linear from:

(S2.8) $Z_{K,t} = a_K K_t, \quad a_K = 2.$

Given the level of K, this technological relationship conditions a certain necessary quantity of skilled labor:

(S2.9) $N_{Dg,t} = \sqrt{2.5K_t} + 42, \quad N_{Dg,t} \leq N_{g,t}.$

It is assumed in (S2.9) that the skilled labor-capital ratio $N_{Dg,t}/K_t$ diminishes with the size of capital. The level of capital stock K in time t is given by

(S2.10) $K_t = I_{K,t-1} + (1-\delta_K)K_{t-1}, \quad \delta_K = 0.14, \ I_{K,t-1} = 120, \ K_{t-1} = 600,$

where I_K is the quantity of investment and δ_K is a depreciation rate.

The total factor productivity then follows to be:

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13) Though the supply of labor is independent of the real wage rate on the whole, workers' labor efficiencies are responsive to the real wages they receive. Hence, employers like efficient wage settings to enhance workers' efforts so that market real wages are higher than the market clearing levels.

(S2.11) $T_t = \{(Z_{K,t-1})^{0.54}(N_{L,t})^{0.36}\}^{\nu}, \quad \nu = 0.1112.$

This reflects a possibility that there may be externalities through changes in the level of aggregate economic activity (learning-by-doing effects, transaction costs, transaction motivations, etc.).

Finally, the macro production function can be written as

(S2.12) $y_{f,t} = (a_K K_{t-1})^{\kappa_1(\nu+1)}[\beta(1-\phi_g)N_0 \exp(\tilde{n}_N t)]^{\kappa_2(\nu+1)},$

This aggregate relationship conditions the economy's potential economic growth[14]. When

(S2.13) $m \equiv (\nu+1)(\kappa_1+\kappa_2) = 1.0001 > 0,$

it implies that for output, there are increasing returns to scale. An increase in aggregate economic activity encourages expansion of the industry; this allows all firms in the industry the possibility of savings from factor inputs[15].

S2-2 Actual utilization rate of capital and labor

The macro production function is a function homogenous of degree m like

(S2.14) $a^m y_{f,t} = [aZ_{K,t-1}]^{\kappa_1(\nu+1)}[aN_{L,t}]^{\kappa_2(\nu+1)}.$

If the actual size of aggregate supply is less than the potential one, existing capital and labor are not fully utilized. Suppose that the production function can be a function homogenous of degree m also in the case of underemployment. Then, we can have

(S2.15) $y_t = \left[a_K K_{t-1}\left(\frac{y_t}{y_{f,t}}\right)^{m^{-1}}\right]^{\kappa_2(\nu+1)}\left[N_{l,t}\left(\frac{y_t}{y_{f,t}}\right)^{m^{-1}}\right]^{\kappa_2(\nu+1)}$

Therefore, denoting the actual use of capital in t by K_t^*, it follows that

---

14) It should be noticed that this does not reflect a full employment state. It leaves out involuntarily unemployment in the long-run; but it does correspond to a fully capital-utilized state.

15) At the micro firm level, factor inputs are often related to output increasingly. But under some macro production function, each factor input is not necessarily increasing with aggregate output. Recent endogenous growth theory argues that the marginal productivity of capital is not decreasing owing to externalities and increasing returns (Aghion and Howitt, 1998).

$$\text{(S2.16)} \qquad K_t^* = \left(\frac{y_t}{y_{f,t}}\right)^{1.0001^{-1}} K_{t-1}, \quad 0 < \left(\frac{y_t}{y_{f,t}}\right)^{1.0001^{-1}} < 1.$$

In the same way, the actual use of skill labor is given by

$$\text{(S2.17)} \qquad N_{Dg,t} = \sqrt{2.5\,K_t^*} + 42.$$

Since $K_t^* < K_{t-1}$, then $N_{Dg,t} < N_{g,t}$. There emerges the unemployment of skill labor. The unemployment rate of skilled labor is calculated by

$$\text{(S2.18)} \qquad u_{g,t} \equiv \frac{N_{g,t} - N_{Dg,t}}{N_{g,t}} = 1 - \frac{\sqrt{2.5K_t^*} + 42}{N_{g,t}} \geq u_{fg,t}(w^*) > 0.$$

u_{fg} is the unemployment rate at the efficiency wage rate, w^*, under the desired utilization of capital stock. The rate $u_{fg,t}$ never becomes zero through firms' efficiency wage setting manner. Since skilled labor can be substituted for ordinary labor, there is effectively no skilled worker without any job. On the other hand, assuming that unutilized skilled labor is inputted first, the actual employment of unskilled labor is stipulated by

$$\text{(S2.19)} \qquad N_{DL,t} = \left(\frac{y_t}{y_{f,t}}\right)^{m^{-1}} N_{L,t} - (N_{g,t} - N_{Dg,t}).$$

Hence, the rate of unemployment for unskilled labor is:

$$\text{(S2.20)} \qquad u_{L,t} \equiv \frac{N_{L,t} - N_{DL,t}}{N_{L,t}}.$$

S3. Aggregate demand

We suppose that the monetary authority can control the change rate of money supply n_M. The money supply to the economy is then subject to:

$$\text{(S3.1)} \qquad M_t = M_0 \exp(n_M t) \text{ or } M_t = (1 + n_M) M_{t-1}, \quad M_0 = 800,\ n_M = 0.02.$$

The real demand and supply for money and credit determine the market rate of interest[16]:

16) This may resemble a type of formulation by a loanable funds model with credit rationing. See Stiglitz and Greenwald (2003) for the whole discussion.

$$\text{(S3.2)} \qquad \frac{M_t}{P_{t-1}}+\omega_{t-1}+A_A = q_y\, y_t+q_\omega y_{t-1}+q_c\, C_t+q_I\, I_{K,t}+q_{\bar{x}}\,\bar{x}_t-q_r\, i_{M,t}.$$

$\bar{x}$ is a sum of exogenous and initial factors (including government expenditures and net exports). The finance motive is built in the money demand function (S3.2). Solving the interest rate,

$$\text{(S3.3)} \qquad i_{M,t} = 1\cdot 10^{-3} y_t+0.025 y_{t-1}+1\cdot 10^{-3} C_t+1\cdot 10^{-3} I_{K,t}$$
$$+1\cdot 10^{-3}\,\bar{x}_t-0.02\left(\frac{M_t}{P_{t-1}}\right)-1\cdot 10^{-3}\omega_{t-1}-20, \quad i_{M,t} \geq i_{M\min} = 0.1.$$

Because investment goods are durable ones, and the repayment of borrowed funds lasts for a long term, agents consider the level of the long-run real rate of interest r_e rather than the present market rate of interest in calculating for the discount or financial costs[17]. An adaptive forecast formation from realized past values is used because general accurate forecast accounting of this interest rate level (%) is reasonably difficult. Namely,

$$\text{(S3.4)} \qquad r_{e,t} = 0.44(r_{t-1}-r_{e,t-1})+r_{e,t-1}+1, \quad r_{e,t-1} = 8.$$

When the nominal rate is i_M and the rate of increase in prices is $\dot{P}$, the realized real interest rate in t is,

$$\text{(S3.5)} \qquad r_t = i_{M,t}-\dot{P}_{e,t}, \quad \dot{P}_{e,t} = \dot{P}_{t-1},\ \dot{P}_{t-1} = -3$$

The aggregate consumption function C reflects habit, wealth, and R&D effects[18]:

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17) A Keynesian understands that any long-term interest is the appropriate weighted average of current and expected future short-term interest rates, plus a term premium (Blinder, 1997, p. 242).

18) If the household maximizes its utility over time, there appears the interest income term in the budget constraint of the household, whose expenditure on each good can be affected by the rate of interest. But taking the real existence of imperfection, incompleteness, uncertainty, and deliberation cost into account, a household's expenditures on goods and labor supply are determined in a heuristic way, and the intertemporal substitution effects seem quite small. Actually, the intertemporal substitution hypothesis has no empirical support. For examples, see Altonji (1986) and Hall (1988). Also, movements in the interest rate give influence to security prices and flow income, but the pluses and minuses are offset at the macro level, and the interest rate effects are small enough to be ignored in this paper.

$$(S3.6)\qquad C_t = 0.31y_{t-1}+0.1C_{t-1}+2.5\rho_{t-1}+3\cdot 10^{-4}\omega_{t-1} +0.01\left(\frac{M_t}{P_{t-1}}\right)+8\cdot 10^{-4}Z_{K,t-2}+1\cdot 10^{-3}\tilde{N}_t+115,\quad C_{t-1}=340,\ K_{t-2}=580.$$

People's consumption heavily depends on disposable income, but also, more or less, on past consumption habits. Also, it is influenced by present and future funds availability and a future income-earning prospect[19]. Furthermore, the consumers' eagerness to purchase will be controlled by the firms' development of new products. Disposable income is a function of aggregate supply. The future funds availability and income-earning prospect are reflected here by ρ. As a whole, the interest rate does not affect the size of aggregate consumption. We suppose that changes in the money supply could provide a good measure of the tightness of credit[20].

A firm's volume of investment for plant and equipment depends on its supply capacity prospects (desirable level of capital stock), expected rate of profit, expected real rate of interest, and the risk-bearing ability, in addition to the prices of related goods and factor inputs. Any decision on investment will depend on its profitability outlook and size of financial costs. Aggregate investment, including both normal and development investments, of the whole economy is given by the following linear equation[21]:

$$(S3.7)\qquad I_{K,t} = 10\rho_{t-1}-1.5r_{e,t}+0.16x_{t-1}+7\cdot 10^{-3}\omega_{t-1} +0.2\left(\frac{M_t}{P_{t-1}}\right)-1\cdot 10^{-3}K_{t-1}+4\cdot 10^{-3}\tilde{N}_t+15,\quad x_{t-1}=560,\ I_{K,t}\geq I_{K\min}.$$

This investment function involves a stock-adjusted investment, and comes with the

19) Individual life average earnings depend on expected wage levels and employment situations, but they are dependent on anticipations of future national income levels. The wages paid by firms depend on the size of the returns to the firms. Each agent's anticipation of his income or of the earnings stream and the movement of net assets can be represented by θ_i.

20) The credit availability for each agent will be affected by the expected earnings of the lenders (banks) , as well as be indirectly affected by the real quantity of money supplied in the economy.

21) However, on the aggregate level, the total investment expenditure is often inelastic with respect to the current market nominal and real interest rates. But the expected interest rate r_e still remains in the investment function as economists commonly recognize the overall importance of real interests, at least, long-term real interests.

presumption that there is no limitation in utilizing skilled worker complementarily with technology embodied in the new physical capital. The last shift term represents a set of exogenous factors such as tax or regulation policy. The capital stock is given as,

(S3.8) $I_{K,t-1}+K_{t-1}-\delta_K K_{t-1}$,

where $\delta_K K_{t-1}$ is a physical depreciation or obsolete part[22].

Also simply suppose that the exogenous variable $\bar{x}$ is subject to:

(S3.9) $\bar{x}_t = \bar{x}_0 \exp(n_{\bar{x}} t)$ or $\bar{x}_t = (1+n_{\bar{x}})\bar{x}_{t-1}$, $\bar{x}_0 = 100$, $n_{\bar{x}} = 0.01$

where $n_{\bar{x}}$ and $\bar{x}_0$ are a periodical growth rate and an initial value, respectively. Then, the aggregate demand function in period t is given by $x_t \equiv C_t+I_{K,t}+\bar{x}_t$.

S4. Pessimism and optimism swings and real interactions

Positively active demand and supply agents would image the distributions of the long-term economic growth rate in each period, respectively, $v_{xi,t}(\theta_{xi,t})$ and $v_{yi,t}(\theta_{yi,t})$. However, since both agents often overlap each other in the economy, their distributive patterns of expectations are similar within the same period. We can assume then, that

(S4.1) $v_{xi}(\theta_{xi}) \approx v_{yi}(\theta_{yi})$,

and the subscripts x and y of θ noting the kind of an agent may be omitted hereinafter. At any period t, any distribution satisfies the following:

(S4.2) $\int_{L_{\theta,t}}^{H_{\theta,t}} v_{i,t}(\theta_{i,t})\,d\theta_{i,t} = 1$,

where H_θ and L_θ represent the highest and the lowest expected growth rate for a

22) Educational investment adds to human capital stock, which possibly allows the people to be higher-grade workers. Still, some skilled workers in a certain period may become unskilled, for instance due to Schumpeterian creative destruction, in the following period. This paper assumes that newly educated workers can replace a band of already commonplace skilled workers. The firms' development intention is accompanied by necessary worker education. Households are willing to spend funds on education to get future higher wages. Skilled workers, reflecting their relatively higher productivity, can have higher wages than average workers do.

particular period, respectively. Giving importance only to the shape of distributions and their local maximal values in the following argument, we can proceed without discussing the determination of both H_θ and L_θ.

Considering the possible coexistence of the bullish and bearish states, i.e., mixed states of expectations, it is convenient to assume that the representative agent faces a continuous distribution of the form:

(S4.3) $$v_{i,t}: R^2 \times R^1 = \{(c_{1,t},\ c_{2,t},\ \theta_{i,t}) | (c_{1,t},\ c_{2,t}) \in R^2,\ \theta_{i,t} \in R^1\} \to R,$$

$$v_{i,t}(c_{1,t},\ c_{2,t},\ \theta_{i,t}) = -\frac{1}{4}(\theta_{i,t}-A_{\theta,t})^4+\frac{1}{2}c_{1,t}(\theta_{i,t}-A_{\theta,t})^2+c_{2,t}(\theta_{i,t}-A_{\theta,t})+\bar{c}_{3,t} > 0,$$

initial and constant values; $c_{1,t} = 5$ $(c_{1,t} \geq 0)$, $c_{2,t} = -3$, $A_{\theta,t} = 0$, $\bar{c}_{3,t} = 5$

where A_θ is the ultimate exogenous shift parameter representing the state of confidence, c_1 and c_2 are coefficient variables, and $\bar{c}_3$ is a constant term. A_θ will be reset due to such unexpected big shocks as innovation, system breakdown, war, or terrorism. The distribution $v_{i,t}$ shows each probability dependent on each growth rate value in period t. The newly introduced variable $\hat{\theta}_{i,t}$ stands for the agent's local maximum.

The shape of the distribution curve v_i given by the above quartic function (i.e., potential function) shows two peaks, or perhaps may show only one depending on the values of the coefficient variable c_1. When $A_\theta = 0$, the following D_θ defined as the discriminant of the root of $dv_{i,t}/d\theta_{i,t} = -(\theta_{i,t})^3+c_{1,t}(\theta_{i,t})+c_{2,t} = 0$ gives basic information on the shape:

(S4.4) $$D_\theta = (c_{2,t})^2-\frac{4}{27}(c_{1,t})^3.$$

Assume that the split factor of the potential function, c_1, is dependent on the GDP percentage of the stock level of real assets in the whole economy. This can be represented in a simple linear relationship of the form,

(S4.5) $$c_{1,t} = 1.15\left(\frac{\omega_t}{y_t}\right).$$

Also shown as a linear relationship, the aggregate real asset balance is determined by

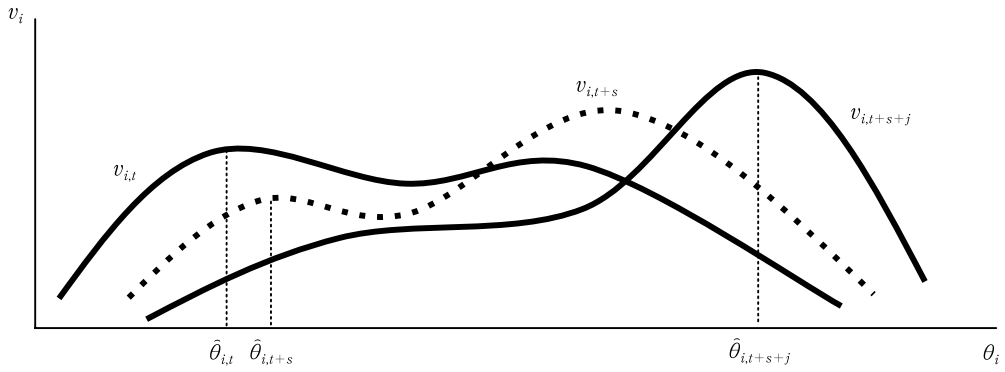

Figure S4. 1. ***Subjective Probability Distribution***

$$\text{(S4.6)} \qquad \omega_t = 0.2y_{t-1} + 1 \cdot 10^3 \dot{x}_t + c_\omega \triangle K_t - 2r_{e,t} + f_\omega (y_{t-1} - x_t) + g_\omega \omega_{t-1},$$
$$c_\omega = 1,\ d_\omega = 2,\ f_\omega = 0,\ g_\omega = 1,$$

where $\dot{x}_t \equiv \dfrac{x_t - x_{t-1}}{x_{t-1}}$ and $\triangle K_t \equiv K_t - K_{t-1}$.

The other coefficient variable, the normal factor c_2, is an increasing function of the actual aggregate demand growth rate $\dot{x}$, in a nonlinear form;

$$\text{(S4.7)} \qquad c_{2,t} = \log \{14\dot{x}_t + \sqrt{(14\dot{x}_t)^2 + 1}\}.$$

Suppose that c_2 increases acceleratingly at first and diminishingly after crossing the point $\dot{x} = 0$ when $\dot{x}$ continuously increases from a negative value.

The agent's decision-making is based on the most feasible growth rate. Simply suppose that this growth rate is the one corresponding to the top of the distribution mountain-shaped curve, $\hat{\theta}_i$. More definitely, if there are two peaks, it signifies the nearest growth rate, corresponding to the local maximum value of the potential function, to the previous rate upon which the agent depended for making decisions. The main concern in the next and subsequent periods is the formation rule of $\hat{\theta}_i$.

If the vector $\boldsymbol{c}_t = (c_{1,t}, c_{2,t})$ changes from the phase with one peak, the height of the peak itself and the corresponding growth rate change, and the peak can become two by some combination. However, he is prudent to switch his actual behavior, for instance, from timid to aggressive, or the converse. The agent is dragged by past expectations until he is able to have enough confidence on a new situation[23]. The

23) In this analysis, the form (S4.3) is taken because it can show three phases of the leaders'

existence of the so called “menu costs”, such as deliberation and switching costs, delays the revision of behavior[24]. Meanwhile, as soon as c_1 changes continuously and the peak changes from two to one, $\hat{\theta}_t$ changes suddenly, corresponding to the top of the single peak (see Figure 4.1). We can observe then a catastrophic change[25].

S5. Social expectations formation

To close the model, we need to discuss the determination of the macro expectations variable ρ_t , which is important in conditioning the sizes of effective aggregate supply and demand. There coexist two types of decision-makers in the society: one who positively prospects the future on the one hand, and the follower of the former type on the other[26]. Business firms are intrinsically the representative group of the former, although there are a considerable number of follower firms. Even if they do business without deep consideration and inconsistently, they know the balance of loss and gain (pains and delights) of being late for the social trend. Some business activities, on the basis of 'peace-at-any-price', accept a trend that can often save deliberation cost, and such conduct is a cheap and wise policy. The whole economy's expectations formation is such that, if in a continuous change in $\hat{\theta}_{i,t}$,

(S5.1) $\rho_t = \mu_0 \hat{\theta}_{i,t} + (1-\mu_0)\rho_{t-1}, \quad \mu_0 = 0.2, \ \hat{\theta}_{i,t} = -2.4909$ (initial value)

Here, μ_0 stands for the constant percentage of leader firms to the whole number of firms. In this setting, follower-typed agents simply and passively inherit the pervious value ρ_{t-1} in period t. They do not care for minor corrections made by leader firms[27].

When there is a sudden big change in the future prospects of the opinion leader agent (group), the follower agent is upset. The followers' customary practices and conservative nature do not allow them to follow the leader simultaneously.

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expectations: (1) unified bullishness, (2) unified bearishness, and (3) the coexistence of bullishness and bearishness. The form (S4.3) surely includes a distribution with two peaks. However, it is not important to compare the height of the possible two peaks.

24) This feature is a sufficient condition to yield hysteresis in the economy.

25) This sudden change may be an example of the cusp-typed catastrophic change shown by Thom (1975).

26) The agents who voluntarily try to form long-term expectations are the former, and they are decision-makers of households and firms with so-called, “positive consciousness”, though exposed to the incompleteness of information and markets.

27) The profit loss of the follower from non-adjustment may be small enough. See Akerlof and Yellen (1985).

Meanwhile, on being able to understand the content of the direction as guided by the leader, they cut off their attitude attached to the past then and there. The information signal given by the leader spreads over all the people and a new social state of expectations is formed about the future real rate of economic growth. If there is a discontinuous change in $\hat{\theta}_{i,t}$, it follows that

$$\text{(S5.2)} \qquad \rho_t = (0.2+\mu_1)\hat{\theta}_{i,t}+(0.8-\mu_t)\rho_{t-1},\ 0.2+\mu_t \leq 1,$$

$$\text{where} \quad \mu_t = \frac{\mu^*}{\mu^*+(1-\mu^*)\exp\{-2(t-a_{cat})\}}, \quad \mu^* = 0.01,\ \mu_t \leq 0.8.$$

μ_t represents the percentage of the follower firms viewing the growth rate as $\hat{\theta}_{i,t}$ in period t. μ^* is the initial value of the percentage of the followers who follow the leader smoothly. The variable a_{cat} is a constant, corresponding to the period when a discontinuous change happens in $\hat{\theta}_{i,t}$, and is left unchanged until the information is completely prevailed upon, that is, $1-\mu_0$. The value of μ_t approaches $1-\mu_0$ over time[28].

When the judgment of the leader has finished spreading, the formation of ρ_t in the following periods becomes subjected again to the equation in (S5.1), so long as the leader does not discontinue its prospects.

S6. Economic fluctuations

The simulation provides two cases, each of which has a different policy combination of the change rate of money supply and that of autonomous demand (Table S6.1). The case (1) follows positive $\hat{\theta}_i$ and ρ in time, though under the splitting state of expectations: a relatively small positive shock can make a big

Table S6. 1. ***Policy Change and Wealth Shock***

	Case (1)	Case (2)						
n_M	0.02 (no change)	0.02 →	0.01 ($t=9$)	→	0.02 ($t=14$)	→	0.03 ($t=16$)	
$n_{\bar{x}}$	0.01 (no change)	0.01 →	0 ($t=9$)	→	0.01 ($t=14$)	→	0.02 ($t=16$)	
ω	No shock	16% down ($t=11$), 16% down ($t=12$)						

28) μ_t does not generally equal $1-\mu_0$ in a discussion of discrete time path. Therefore, if $\mu_{t-1} < 1-\mu_0$ and μ_t of the next period exceeds $1-\mu_0$, we judge that μ_t reaches $1-\mu_0$ within period , thus the setting $\mu_t = 1-\mu_0$.

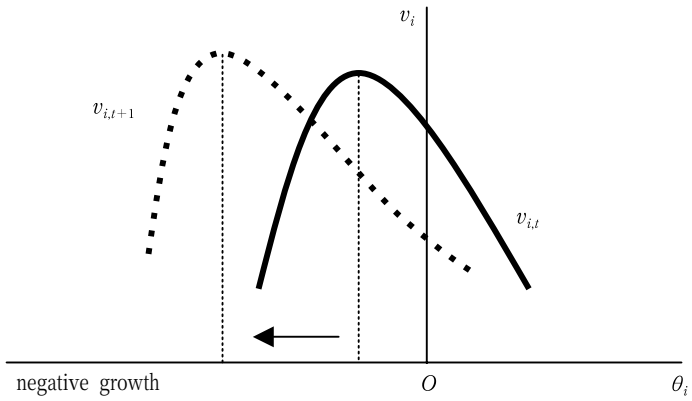

Figure S6. 1. ***Increment in*** c_1 ***and a Deeper Expectational Trap: The Case of USBE*** $(D > 0)$

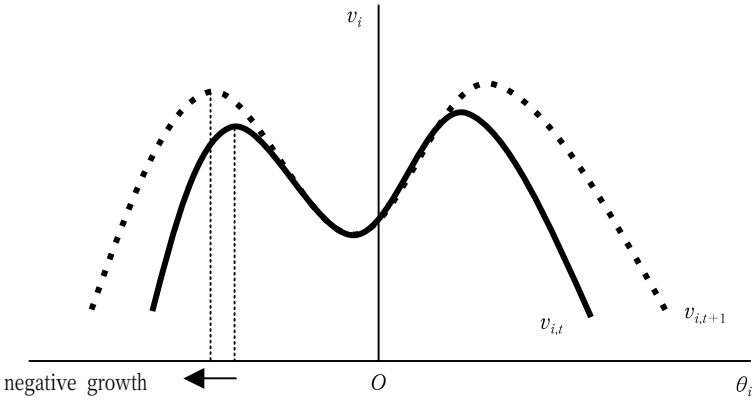

Figure S6. 2. ***Increment in*** c_1 ***and a Deeper Trap: The Case of SSE*** $(D < 0)$

upward-jump in the economy. On the other hand, the case (2) exemplifies a trap of pessimistic expectations, in which the economy has only the almost same growth level as the case (1) notwithstanding a high stimulus operation of anti-cyclical policy. Thus, compared with the case (1), a recovery of the economy needs a much more positive monetary and fiscal policy combination (Table S6.2)[29].

What the present analysis supplemented by the simulation model suggests is that even the same size of policy change shows a different effect according to a different state of expectations. In a deep trap of pessimistic outlooks, there does not yield any significant effectiveness by an ordinary size of expansion policy. The repeated introductions of monetary and fiscal expansion policies that have little effect on the whole economy result only in cumulative governmental deficits and creeping

29) For the whole figure of the simulations, see Okamura (2004).

Table S6.2. Numerical Examples (1/2)

	Case (1)								Case (2)							
t	r_e	x	y	u_g	u_L	P	ω	ρ	r_e	x	y	u_g	u_L	P	ω	ρ
1	7.68	539	578	3.46	7.18	9.55	2104	-2.81	7.68	539.3	577.7	3.46	7.18	9.55	2104	-2.81
2	6.66	534	588	3.59	9.25	9.56	2214	-2.73	6.66	533.5	587.8	3.59	9.25	9.56	2214	-2.73
3	5.92	539	590	4.29	11.14	9.56	2348	-2.49	5.92	539.5	589.9	4.29	11.14	9.56	2348	-2.49
4	4.31	549	607	4.43	10.28	9.57	2492	-2.25	4.31	549.3	607.4	4.43	10.29	9.57	2492	-2.25
5	3.46	563	618	4.84	10.52	9.58	2654	-1.24	3.46	563.3	618.3	4.84	10.54	9.58	2654	-1.24
6	2.91	586	653	4.32	7.35	9.61	2837	-0.20	2.91	585.7	653.0	4.32	7.37	9.61	2837	-0.20
7	2.63	617	682	4.00	5.47	9.64	3052	1.38	2.63	617.0	682.1	4.01	5.49	9.64	3052	1.38
8	2.37	656	732	2.87	1.40	10.75	3295	2.67	2.37	655.8	731.9	2.88	1.42	10.75	3294	2.67
9	8.12	688	748	2.81	3.17	10.86	3537	2.68	8.12	686.4	745.5	2.90	3.54	10.86	3535	2.68
10	6.91	705	766	2.51	5.48	10.89	3764	2.68	6.92	701.3	761.7	2.67	6.12	10.88	3757	2.68
11	10.96	711	762	3.02	10.63	10.90	3970	2.68	10.95	705.3	754.0	3.27	11.59	10.88	3167	2.63
12	13.63	711	765	3.29	14.24	10.87	4149	2.63	13.62	695.6	742.3	4.06	17.04	10.91	2664	1.58
13	15.07	712	764	3.86	17.60	10.85	4319	2.63	15.37	671.2	704.6	5.89	24.76	10.88	2786	0.47
14	15.95	714	768	4.34	17.60	10.84	4482	2.65	16.32	642.3	682.9	7.34	29.56	10.77	2866	-1.23
15	16.29	718	773	4.91	21.47	10.83	4643	2.68	16.53	610.3	639.4	9.76	35.93	10.66	2918	-2.67
16	16.45	723	779	5.45	22.73	10.83	4803	2.72	16.68	575.8	611.8	11.75	39.78	10.53	2934	-2.68
17	16.45	730	785	6.03	23.81	10.83	4963	2.75	16.17	564.0	615.1	12.78	39.29	10.48	2966	-2.67
18	16.43	736	792	6.61	24.74	10.83	5124	2.79	15.64	566.4	616.7	13.98	38.44	10.47	3025	-2.56
19	16.39	743	799	7.19	25.60	10.84	5287	2.82	15.05	573.2	628.6	14.81	36.31	10.48	3100	-2.44
20	16.36	751	807	7.79	26.41	10.84	5449	2.85	14.44	584.2	638.9	15.66	34.47	10.50	3193	-2.34
21	16.33	758	814	8.39	27.17	10.85	5613	2.88	14.15	595.2	650.7	16.39	32.68	10.52	3296	-2.26
22	16.31	765	821	8.99	27.91	10.85	5778	2.91	13.97	606.4	661.3	17.10	31.34	10.55	3409	-2.20
23	16.29	772	828	9.60	28.62	10.85	5944	2.94	13.95	616.8	671.8	17.76	30.30	10.56	3527	-2.17
24	16.27	779	835	10.20	29.30	10.86	6112	2.97	13.98	626.8	681.5	18.39	29.60	10.58	3652	-2.15
25	16.25	786	843	10.81	29.95	10.86	6280	2.99	14.06	636.4	691.0	18.98	29.14	10.59	3780	-2.15
26	16.23	794	850	11.42	30.59	10.86	6450	3.02	14.14	645.8	700.3	19.56	28.87	10.60	3913	-2.15
27	16.22	801	857	12.03	31.20	10.87	6621	3.05	14.21	655.1	709.5	20.11	28.74	10.61	4048	-2.16
28	16.20	808	865	12.64	31.80	10.87	6793	3.07	14.28	664.3	718.8	20.64	28.72	1062	4188	-2.18
29	16.17	816	872	13.24	32.38	10.87	6967	3.10	14.34	673.6	728.1	21.15	28.77	10.63	4330	-2.20
30	16.15	823	880	13.84	32.95	10.88	7142	3.12	14.38	683.0	737.6	21.65	28.89	10.64	4476	-2.23
31	16.13	831	887	14.45	33.50	10.88	7319	3.14	14.42	692.6	747.2	22.13	29.05	10.65	4624	-2.25
32	16.11	838	895	15.04	34.04	10.88	7497	3.17	14.46	702.3	757.1	22.60	29.25	10.66	4776	-2.28
33	16.08	846	903	15.64	34.57	10.89	7677	3.19	14.49	712.2	767.1	23.06	29.47	10.67	4930	-2.31
34	16.06	854	910	16.23	35.09	10.89	7859	3.21	14.51	722.4	777.3	23.51	29.70	10.68	5087	-2.34
35	16.03	862	918	16.82	35.60	10.89	8043	3.23	14.53	732.7	787.8	23.94	29.96	10.69	5248	-2.37
36	16.00	869	926	17.41	36.09	10.90	8228	3.26	14.56	743.3	798.5	24.37	30.22	10.70	5411	-2.40
37	15.97	877	934	17.99	36.58	10.90	8415	3.28	14.58	754.1	809.4	24.79	30.49	10.71	5577	-2.43
38	15.95	885	942	18.57	37.07	10.90	8604	3.30	14.60	765.2	820.6	25.20	30.76	10.72	5746	-2.46
39	15.92	894	951	19.14	37.54	10.90	8795	3.32	14.62	776.5	832.0	25.60	31.03	10.73	5919	-2.48
40	15.88	902	959	19.71	38.01	10.91	8987	3.34	14.64	788.0	843.7	25.99	31.30	10.74	6094	-2.51
41	15.85	910	967	20.28	38.47	10.91	9182	3.36	14.66	799.9	855.7	26.37	31.57	10.75	6273	-2.54
42	15.82	919	976	20.84	38.92	10.91	9378	3.38	14.68	812.0	867.9	26.75	31.84	10.76	6454	-2.57
43	15.79	927	984	21.40	39.36	10.92	9577	3.40	14.71	824.4	880.5	27.12	32.11	10.77	6640	-2.59

Table S6.2. Numerical Examples (2/2)

	Case (1)								Case (2)							
t	r_e	x	y	u_g	u_L	P	ω	ρ	r_e	x	y	u_g	u_L	P	ω	ρ
44	15.75	936	993	21.95	39.80	10.92	9777	3.42	14.73	837.1	893.3	27.48	32.37	10.79	6828	−2.62
45	15.72	944	1002	22.50	40.24	10.92	9980	3.44	14.75	850.1	906.4	27.84	32.63	10.80	7020	−2.64
46	15.68	953	1010	23.05	40.67	10.92	10185	3.46	14.78	863.3	919.8	28.18	32.88	10.81	7215	−2.67
47	15.64	962	1019	23.59	41.09	10.93	10391	3.48	14.80	876.9	933.6	28.53	33.13	10.82	7413	−2.69
48	15.60	971	1028	24.13	41.51	10.93	10600	3.50	14.83	890.8	947.6	28.86	33.37	10.84	7616	−2.72
49	15.56	980	1037	.24.66	41.92	10.93	10811	3.52	14.86	905.0	962.0	29.19	33.60	10.85	7821	−2.74
50	15.52	989	1047	.25.19	42.33	10.94	11025	3.53	14.89	919.5	976.7	29.51	33.83	10.86	8031	−2.76
51	15.48	998	1056	25.71	42.73	10.94	11240	3.55	14.92	934.4	991.7	29.83	34.05	10.88	8244	−2.78
52	15.44	1007	1065	26.23	43.12	10.94	11458	3.57	14.95	949.6	1007.1	30.14	34.27	10.89	8461	−2.80
53	15.40	1017	1075	26.75	43.52	10.94	11678	3.59	14.98	965.1	1022.8	30.44	34.48	10.91	8683	−2.82
54	15.35	1026	1084	27.26	43.90	10.95	11900	3.61	15.01	981.0	1038.8	30.74	34.68	10.92	8908	−2.84
55	15.31	1036	1094	27.77	44.29	10.95	12125	3.62	15.05	997.3	1055.3	31.04	34.88	10.94	9137	−2.86
56	15.26	1046	1104	28.27	44.67	10.95	12352	3.64	15.08	1013.9	1072.0	31.33	35.07	10.96	9370	−2.88
57	15.21	1056	1114	28.77	45.04	10.96	12582	3.66	15.12	1030.9	1089.2	31.61	35.25	10.97	9608	−2.90
58	15.16	1066	1124	29.27	45.41	10.96	12814	3.67	15.16	1048.2	1106.8	31.89	35.43	10.99	9850	−2.92
59	15.11	1076	1134	29.76	45.77	10.96	13048	3.69	15.19	1066.0	1124.7	32.16	35.60	11.01	10097	−2.94
60	15.06	1086	1144	30.25	46.14	10.96	13285	3.71	15.23	1084.1	1143.0	32.43	35.76	11.02	10348	−2.95

inflation, or sometimes, even in stagflation.

In this situation of sequent negative $\hat{\theta}_i$ and ρ, which are negative factors to let demands for investment and consumer goods decrease, a stimulus policy sustains the positive actual growth of the economy. Any positive growth increases the level of ω. An increasing ω commonly raises the level of c_1. After all, it leads to debasements in $\hat{\theta}_i$ and ρ under the case of almost constant c_2 (Table S6.2, Figure S6.1 -2). It may be understood in this causation that the accumulation of public bonds issues to sustain the economy's flow growth under a bearish situation produces worse future expectations[30].

30) Barro (1974) argued the impotence of debt-financed fiscal stimulus (Ricardian equivalence hypothesis) ; in response to a rise in government debt, rational private agents raise saving in expectation of higher future taxes. In this case of my present analysis, it yields the more pessimistic state of future growth expectations, which negatively influences consumption and investment (see the equations, S3.6 and S3.8).

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