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Labor Productivity Stagnation, the Radical Quantitative Easing Monetary Policy, and Disinflation

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Abstract

There is an anomaly observed in many advanced economies- disinflation accompanied by stagnation of labor productivity. In a static barter economy, this phenomenon is incomprehensive because labor productivity stagnation relative to aggregate demand raises price levels. That is, theoretically, disinflation can coexist only with the rapid progress of labor productivity. I construct an overlapping-generations model (OLG model), which predicts disinflation caused by slowdown in labor productivity. The crucial factor is that demand for current goods can decrease when labor productivity slows down. This implies that disinflation and recession coexist to keep the equilibrium in the goods market. In addition, I clarify the reason why quantitative easing (QE) policy such as those seen in Japan and other advanced economies causes mild disinflation.

Keywords: Labor Productivity Stagnation, Radical QE Policy, Disinflation, Stagflation as Bust of Money Bubble

1 Introduction

As suggested in Table 4.1, disinflation and the slowdown of labor productivity growth is prominent in advanced countries. Beyond the issue of measurement errors,[1] these phenomena are related to different factors. For example, according to ECB (2016), labor productivity slowdown in the U.S. is mainly attributed to

(i) Decrease in capital deepening, and

(ii) the slowdown of total factor productivity (TFP) growth.

On the other hand, as a key variable of disinflation, inflation expectations are frequently examined although there findings span a wide range. Christensen (2009) revealed that minor investors held deflationary expectations even during the deflation era in the U.S. Piazza (2015) found that Japanese deflationary expectations are prominent compared with the world economy. Hori and Shimizutani (2005) showed that

[1] For example, Byrne, Fernald, and Reinsdorf (2016) argue it is difficult to find productivity slowdown in the U.S. despite the substantial measurement errors.

Japanese inflation expectations are strongly affected by their own lagged variables.

However, the slowdown of capital deepening or TFP is not consistent with disinflation in the classical static model, regardless of what price expectations may be. For example, let us consider a classical two production factors linear homogenous production function model, which the TFP analysis implicitly assumes. If capital deepening decelerates, labor becomes the abundant resource. Accordingly, the real wage becomes lower relative to the real rent. Thus, the real wage strictly decreases. Nevertheless, this model does not possess the power to determine the price level because it is a classical real model, which cannot introduce money endogenously. Hence, by definition, it is impossible to know whether disinflation occurs or not.

Instead, consider the case in which capital accumulation takes time to be effective, and capital is a quasi-fixed factor in the short run. Hence, labor is the only variable production resource. In such a case, if nominal wage is fixed, the price level potentially increases. This is because the real wage must be lowered to maintain full employment equilibrium. It is not deflation but *static* inflation. It must be noted that this scenario, which is based on the standard Keynesian theory, is a variant of the stagflation model of Bruno and Sachs (1985), and thus, neither the neoclassical nor Keynesian type models can explain the coexistence of disinflation and labor productivity slowdown since a model is basically *static*.

Therefore, we must note that disinflation is a dynamic phenomenon in a monetary economy. The current and future economy is linked through money. In addition, output price is measured in terms of money. Accordingly, we need a dynamic model with money to analyze the coexistence of disinflation and productivity slowdown.

The two period overlapping-generations (OLG) model with money is the simplest and most suitable analytical tool. As developed in Otaki (2007, 2009, 2015), this type of OLG model has the property that the value of money (the inverse of the price index) is determined by the rational expectation of its own future value, and thus, unemployment emerges whenever the real cash balance is sufficiently small with no rigidity assumption on prices. I assume a linear production function of labor with exogenously given labor productivity to facilitate the comparative statics.

An exogenous labor productivity slowdown implies that the current potential aggregated supply is curtailed. Since young individuals' consumption is an increasing function of the *ex-ante* inflation rate, which is equal to the *ex-post* inflation of the next period under rational expectation equilibrium (REE), disinflation is provoked to equilibrate the current goods market. Thus, in a monetary economy, disinflation can coexist with a productivity slowdown.

It is important to distinguish between *ex-post* and *ex-ante* inflation. Let t be the current period. Then, the ex-post inflation, π^{EP}, is defined as

$$\pi^{EP} \equiv \frac{p_t}{p_{t-1}}. \qquad (1)$$

The *ex-ante* rational expectation, π^{EX}, which affects young individuals' decision, is

$$\pi^{EX} \equiv \frac{p_{t+1}}{p_t}. \qquad (2)$$

As discussed above, the *ex-post* inflation rate can be derived from the comparative statics of a neoclassical model. However, the *ex-ante* inflation rate, which is equal to the future actual inflation rate (*ex-post* inflation rate during period $t+1$ under REE), can only be derived in dynamic model. It must be noted that what is important for determining the equilibrium is the *ex-ante* inflation rate, and not the *ex-post* inflation rate, because those who substantially determine the resource allocation of the overall economy are the current young generation. The classical static model cannot derive the ex-ante inflation rate by definition. The strict distinction between the price level and inflation rate is crucial for macroeconomic theory.

Regarding the origins of deflation, my model is also useful in analyzing the consequences of the radical quantitative easing (QE) monetary policy. Disinflation continues in advanced economies despite the intention of the radical QE policy. This is paradoxical for those who follow quantity theory including New Keynesians.[2] In contrast to this, my model can explain this phenomenon.

The OLG model assumes that individuals are *confident* of the intrinsic value of money in the sense that they rationally believe the current price level is independent of the nominal money supply. An increase in the nominal money supply requires deflation. This is because the aggregate saving of the young generation should increase to equilibrate the money market.

The most prominent future of the OLG model is that a change in some stock macroeconomic variable such as the nominal money supply can *directly* affect flow variables. Traditional IS/LM analysis (including sophisticated versions of new Keynesian) cannot analyze how the new monetary inflow affects the equilibrium condition of the goods market. If a change in the stock variable is negligibly small, the IS/LM method can be considered a reasonable first-order approximation. However, the

[2] Gali (2008) is a standard text of New Keynesian economics. The real cash balance is introduced in the utility function. This implies that the real cash balance become an endogenous variable, and hence, the price level varies proportionately to the nominal money stock, at least, in the long run. This property clarifies that neutrality of money (i.e., quantity theory of money) holds in New Keynesian model.

volume of the radical QE policy per annum is huge, and thus, the OLG model is far more suitable than the IS/LM analysis to investigate its effects on the overall economy.

This paper is organized as follows. Section 3.2 constructs a classical static model and a dynamic OLG model to exhibit different insights into the coexistence of disinflation and labor productivity slowdown. In Section 3.3, I critically analyze effects of the radical QE monetary policy by using the OLG model constructed in Section 3.2. Section 3.4 contains concluding remarks.

2 The Model

2.1 The Classical Real Model

I consider an economy in which one good is produced by one production resource: labor. The utility function, U, of the representative individual is assumed to be

$$U \equiv x - G(h), \quad G' > 0, G'' > 0, \ \lim_{h \to 0} G'(h) = 0, \lim_{h \to +\infty} G'(h) = +\infty, \qquad (3)$$

where x denotes the volume of consumption and h is the hours worked. $G(\cdot)$ function represents the disutility from labor. The budget constraint is

$$Wh \geq px \Leftrightarrow \frac{W}{p} h \geq x, \qquad (4)$$

where W denotes the nominal wage. p is the price of goods.

From the Inada condition in Equation (3), the budget constraint, Equation (4), is always biding. Therefore, the maximization problem, which the representative individual solves, is

$$\max_h \left[\frac{W}{p} h - G(h) \right] \Leftrightarrow \frac{W}{p} = G'(h). \qquad (5)$$

Production is assumed to be linear on hours worked:

$$x = \gamma h. \qquad (6)$$

Goods and labor markets are under perfect competition. Substituting Equation (4), the zero-profit condition implies

$$\pi \equiv px - Wh = 0 \quad \Leftrightarrow \quad \frac{W}{p} = \gamma. \ (7)$$

Accordingly, the labor productivity is equalized to the real wage. The equilibrium of the goods market is illustrated by Point E in Figure 1. It is evident from Figure 1 that the optimal hours worked, h^*, is an increasing function of the labor productivity γ. That is,

$$h^* = \varphi(\gamma), \varphi' > 0. \quad (8)$$

Here we assume that nominal wage, W, is the numeraire. Then, we can determine the price of goods in terms of the nominal wage. Let this variable be denoted p_w Since the labor productivity is equal to the real wage (see Equation (7)), the price, p_w, always increases when labor productivity slows down. Thus, *ex-post* inflation as represented in Equation (1) is triggered by such a slowdown.

Furthermore, the curtailed real wage decreases the equilibrium hours worked, h^*. This implies that stagflation occurs in this economy. It should be noted that this property of the static neoclassical model is quite robust as shown in Bruno and Sachs shows.

Figure 2 illustrates the equilibrium of the goods market from the another point of view. Horizontal line SS is the supply curve is defined in Equation (7).[3] The downward-sloping curve DD is the demand curve of the goods. This curve can be derived in the following way. First, the optimal hours worked h^* is a decreasing function of the goods price p_w. Second, from the budget constraint Equation (4), it is evident that the optimal consumption, x^*, increases in conjunction with h^*. Consequently, x^* is a decreasing function of p_w, and hence, the demand curve DD becomes downward sloping. The equilibrium is achieved at Point E.

It is also straightforward from Figure 2 that the equilibrium moves towards the northwest point of DD such as Point E_1 whenever labor productivity slowdown is provoked as a consequence of the upward shift of supply curve SS. This is the essence of the supply-shock model developed by Bruno and Sachs (1985).

To summarize, the real static model cannot explain the coexistence of disinflation and the labor productivity slowdown. This fact suggests that a dynamic model with money is needed to solve this paradox.

2.2 The Two Period Overlapping-Generations Model

I construct a two period OLG model with money and infinite time horizon in a production economy, which is developed by Lucas (1972) and Otaki (2007, 2009, 2015). The utility function, V, of representative individual who is born at the beginning period t is

$$V \equiv v(x_{1t}, x_{2t+1}) - G(h_t), \quad (9)$$

[3] If the aggregate production is concave, it is easy to show that the aggregate supply curve SS becomes upward sloping. However, parameter γ becomes the TFP at this time.

where $v(\cdot)$ represents the utility from lifetime consumption. x_{it+j} denotes the consumption of an individual during period $t+j$ at the i th stage of his life. This function is strictly concave and a linear homogenous function. $v(\cdot)$ also satisfies the Inada condition. The corresponding budget constraint is

$$W_t h_t \geq p_t \left[c_{1t} + \rho c_{2t+1} \right], \qquad \rho \equiv \frac{p_{t+1}}{p_t}. \qquad (10)$$

It is well known that the corresponding indirect utility function, ID, of $v(\cdot)$ can be represented as

$$ID \equiv \frac{W_t h_t}{\psi(p_t, p_{t+1})}, \qquad (11)$$

where $\psi(\cdot)$ is a monotonously increasing linear homogenous function. The optimal decision requires the following condition:

$$\frac{d}{dh_t} ID_t = G'(h_t) \Leftrightarrow \frac{W_t}{\psi(p_t, p_{t+1})} = G'(h_t) \Leftrightarrow W_t = \psi(p_t, p_{t+1}) \cdot G'(h_t). \qquad (12)$$

Accordingly, the firm's zero-profit condition requires

$$p_t \gamma - W_t^R = 0 \Leftrightarrow p_t \gamma - W_t = p_t \gamma - \psi(p_t, p_{t+1}) \cdot G'(h_t) = 0 \Leftrightarrow \gamma = \psi(1, \rho) \cdot G'(h_t). \quad (13)$$

where ρ is the *ex-ante* inflation rate as previously defined in Equation (1).

Equation (13) is the implicit aggregate supply function of this model. The right-hand side of the equation is an increasing function of h_t and ρ. Hence, the aggregate supply function is a downward sloping like Curve AS in Figure 3. It should be noted that the vertical axis is the inflation rate ρ, and not the price level p_t. When inflation advances, the nominal wage, W_t, increases because future goods become expensive relative to current goods. This dampens labor demand because profits become negative if a firm does not reduce hours worked. Accordingly, the aggregate supply, y_t^S, decreases as inflation advances. This is how Curve AS is derived.

The labor productivity γ is a vital parameter of the aggregate supply function as shown in Equation (13). Suppose that the hours worked, h_t, is kept constant and that the labor productivity slows downs (γ becomes a smaller value than before). Then, the (*ex-ante*) inflation rate, ρ, decreases and disinflation occurs. The decreased labor productivity

curtails the aggregate supply, and hence, aggregate consumption must also decrease. The aggregate consumption of young individuals is an increasing function of ρ .[4] Therefore, ρ decreases to equilibrate the goods market. Thus, whenever the labor productivity stagnates, Curve AS shifts downward.

Let us now consider the aggregate demand, y_t^D . The aggregate demand comprises three items: young generation's consumption; old generation's consumption; and the government consumption. Young generation's consumption, c_{1t} , becomes

$$c_{1t} = c(\rho) y_t, 1 > c' > 0, \qquad (14)$$

because the lifetime utility function on consumption is homothetic. Since the old generation is assumed to have no incentive to pass on inheritance, they exchange the all their money, which they carried over from the previous period, and thus,

$$c_{2t-1} = \frac{M_{t-1}}{p_t} \qquad (15)$$

holds. The budget constraint of the government is as follows:

$$g_t \equiv \frac{M_t}{p_t} - \frac{M_{t-1}}{p_t}. \qquad (16)$$

This identity implies that the government finances its consumption by seigniorage.

From Equations (14), (15), and (16), the aggregate demand, y_t^D , can be defined as

$$y_t^D \equiv c(\rho) y_t + \frac{M_{t-1}}{p_t} + g_t = c(\rho) y_t + m, \text{ where } m \equiv \frac{M_t}{p_t} = \frac{M_{t+j}}{p_{t+j}}, \forall j \geq 0. \qquad (17)$$

To find the equilibrium with the zero-profit condition of the firm, we can set

$$y_t^D = y_t^S = y_t. \qquad (18)$$

Using Equation (18), Equation (17) can be transformed into

$$y_t = c(\rho) y_t + m \quad \Leftrightarrow \quad y_t = \frac{m}{1 - c(\rho)}. \qquad (19)$$

Equation (19) is the equation of the aggregate demand. When the inflation rate increases, the equilibrium GDP, y_t , increases. Thus, the aggregate demand function AD becomes upward sloping. In addition, when real cash balance, m , increases, *ceteris paribus*, Curve

[4] Here I analyze properties of the aggregate supply curve. However, information on the demand side of the goods is inseparable from the analysis. This is because the indirect lifetime utility function, ID , contains information on the demand function.

AD in Figure 3 shifts right because of the multiplier effect. Equilibrium of the economy is achieved at Point E^K , which is the intersection of Curves AS and AD .

3 Comparative Statics

This section considers how exogenous economic shocks affect the macroeconomic equilibrium. Three shocks are analyzed: labor productivity slowdown; radical QE monetary policy; and stagflation provoked by the lack of belief in the intrinsic value of money.

3.1 Labor Productivity Slowdown

An autonomous labor productivity slowdown is represented by the reduction of parameter, γ . As described in Section 2, this causes a downward shift of the AS curve. Figure 4 illustrates the consequence. The equilibrium moves from Point A to A_1 . Accordingly, the slowdown of labor productivity and disinflation coexist in our theory.

The causality is as follows. An autonomous labor productivity slowdown decreases the aggregate supply, and excess demand emerges in the goods market. Assume that individuals are *confident* of the current intrinsic value of money, $\frac{1}{p_t}$, then by definition, the current price level, p_t , is unchanged[5]. It is plausible to assume that individuals anticipate the future price, p_{t+1}, to be lower because the economy will sufficiently adapt to the labor productivity slowdown. Thus, rational *ex-ante* deflationary expectations are generated and disinflation is realized. Such disinflation reduces the aggregate consumption of the young generation, and hence equilibrates the goods market. It also should be noted that the economy falls into recession because of the decrease in aggregate consumption.

3.2 Effect of Radical QE Monetary Policy

The radical QE monetary policy shifts the aggregate demand curve AD towards the right as in Figure 5. The economy moves from Point B to B' . Business upturns in conjunction with disinflation.

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[5] My model can determine only the relative value of money (the inverse of the inflation rate). It is necessary to determine the value of the sequence of price levels to establish the initial condition of the price level. This value is arbitrarily given. The condition for ‘ *confidence* ’ is developed by Otaki (2015), which implies that the current absolute value of money, $\frac{1}{p_t}$, is independent of the nominal money supply.

This property of the model is quite similar to the current situation faced by the Japanese economy. The QE policy, which injects a huge amount of money into the economy, requires the same amount of new demand for money. As Equation (19) shows, aggregate saving is an increasing function of GDP and a decreasing function of the inflation rate. Accordingly, GDP increases (the multiplier effect) and the inflation rate is reduced. Since the aggregate supply function, Equation (13), is a decreasing function of the inflation rate, an increase in GDP and a deceleration of inflation is consistent with the change on the demand side.

In other words, the inflation rate must fall to create new demand for money to equilibrate the money market. Disinflation also helps to increase aggregate income because disinflation lowers real wage per capita in terms of current goods. It should be noted that disinflation is a phenomenon which increases the rate of return for money. Money has two aspects: a measure for exchange and its intrinsic value that it holds within. These social roles of money are inseparable.[6] When the rate of return increases, much money is carried over for future consumption.

Followers of the quantity theory of money forget this fact. Monetarism, including the new Keynesian's real cash balance in the utility function, has no microeconomic foundation for money demand. Many central banks follow the quantity theory. They believe their economy can escape from disinflation if sufficient money is injected despite the fact that radical QE monetary policy actually provokes disinflation and/or deflation.

As long as the intrinsic value of money is in a state of *confidence*, disinflation prevails despite the intent of the central bank. However, there is no denying that there is indeed a limit of the nominal money supply where individuals can maintain *confidence* in money. Once the volume of the nominal money supply exceeds this critical point, hyperinflation (bust of the *money* bubble) is inevitably provoked. Details will be discussed in the next section.

3.3 Stagflation: Bust of the Money Bubble

Bruno and Sachs (1985) regard stagflation as the upward shift of the aggregate supply curve like AS' in Figure 2 caused by circumstances as a crude oil price hike.

My model predicts such supply shocks, which aggravates labor productivity, causes disinflation. Which of the two phenomena is actually realized can only be determined by a precise and careful empirical analysis. While stagflation, which Bruno-Sachs originally

[6] For a proof on the inseparability of money's two roles, see Otaki (2015, Ch.15).

illustrated, was a temporary phenomenon, most stagflations observed in Greece, South American countries, and African countries are actually persistent. Such phenomenon comes from the lack of belief in the intrinsic value of money.

It should be noted that money belongs to a class of ‘ bubbly assets ’ in the sense that fiat money is an asset which possesses no economic value in itself. However, individuals believe its intrinsic value to the extent that the circulated money is scarce relative to

(i) the potential production capacity of an economy, and;

(ii) the levying ability of the government.

Whenever the production level approaches full capacity, the economy has no room for providing goods for additionally issued money. If either of these two conditions is not satisfied, individuals tilt lose faith in the intrinsic value of money, which is based on the social benefits derived from overcoming *the difficulty of the double coincident of wants*. Even money loses its *confidence*, if conditions (i) or (ii) is not satisfied. That is, individuals become skeptic whether money can be used to exchange for goods at any given time.

In such a case, stagflation is provoked in the following way. Individuals rush to the goods market, and the price hikes rapidly. The real cash balance $m \equiv \frac{M_t}{p_t}$ decreases. This shifts Curve AD upwards, and hence, equilibrium moves from Point C to C_1 as in Figure 6.

This implies that the increase in the current price level p_t deprives the purchasing power of the old generation and government, and thus, results in the fall of GDP, y_t . *Ex-post* stagflation is provoked in the sense of Equation (1). Distinct from the Bruno-Sachs model, such stagflation, which is triggered by a lack of the intrinsic value of money is persistent. To offset the reduction of the aggregate demand, the equilibrium inflation rate stays at a high level because a higher inflation rate stimulates the consumption of the young generation. In other words, the young generation also loses faith in the value of money. I have implicitly assumed the policy variable to be real cash balance. Accordingly, even though the government increases the nominal money supply proportional to the inflation rate, the economy continues to be stuck in a devastating economic situation.

As discussed in Subsection 3.2, the radical QE monetary policy is effective to the extent that individuals are confident of the intrinsic value of money (although the effect on inflation rate does not satisfy central banks). However, there is a limit in this kind of monetary policy. When the real cash balance exceeds the upper bound that might be

prescribed in conditions (i) and (ii), belief in the intrinsic value of money is impaired, and hence hyperinflation and persistent stagflation will ensue. It is an ironical historical fact that the socialist leader Lenin advocated this is the fastest way to annihilate the monetary system and collapse capitalism.

4 Concluding Remarks

This chapter examined how labor productivity slowdown affects the inflation rate. In addition, I analyzed the relationship between the radical QE monetary policy and the inflation rate. Findings are as follows.

First, the standard neoclassical model fails to explain the coexistence of the labor productivity slowdown and disinflation. Intuitively, as the Bruno-Sachs (1985) model suggests, such a slowdown triggers an upward shift of the aggregate supply curve. Hence, to the extent that the aggregate demand curve stays intact, the economy falls into stagnation with an increased equilibrium price. (i.e., *static* stagflation, which implies the occurrence of a one time jump of current prices).

Second, in contrast to the neoclassical model, the Keynesian OLG model predicts that a labor productivity slowdown triggers disinflation. The causality is as follows. A labor productivity slowdown curtails aggregate supply. Whenever individuals are confident of the intrinsic value of money, by definition, the current price remains at the same level, and thus, excess demand emerges. Individuals rationally anticipate that the economy will adapt to the productivity slowdown, and reduce the potential excess demand, and hence, expect the *equilibrium* future price level to be lowered relative to the current level. As such, disinflation occurs. Since the consumption demand of the young generation is an increasing function of the inflation rate, disinflation curtails the current aggregate demand. Through this process, the equilibrium of the overall economy is achieved. Namely, I ascertain the causality by which the slowdown in labor productivity is connected with disinflation.

Third, I have ascertained that the radical QE monetary policy advances disinflation. The radical QE monetary policy has two aspects. One aspect is that real cash balance is drastically increased as long as *confidence* in money is retained. The rate of return for money (the inverse of the inflation rate) increases to equilibrate the money market (the reverse side of the goods market), and thus, disinflation advances. The other aspect is that the increased real cash balance expands the aggregate demand, and recovers the business through the multiplier process. Accordingly, business booms and disinflation coexist under the radical QE monetary policy, as long as individuals retain *confidence* .

Finally, I clarified how persistent stagflation is provoked by a lack of belief in the intrinsic value of money. As discussed above, the Bruno-Sachs (1985) model describes stagflation as a transition process caused by a supply shock such as crude oil price hike. A negative supply shock shifts the aggregate supply curve leftward. As a result, price of goods price also hikes and the equilibrium GDP decreases. Nevertheless, their model is basically static, and the hike of the output price is temporary. Actual stagflation provokes more persistent inflation along with mass unemployment. In fact, most developing economies are burdened by this kind of structural stagflation. Lack of belief in the intrinsic value of money is considered to be provoked by the following two conditions:

(1) a huge amount of money stock relative to an economy's potential production capacity, and;

(2) an inadequate levying ability of the government.

If either condition (1) and/or (2) is satisfied, individuals become skeptical about the exchangeability of money for goods. Consumers are confident of the intrinsic value of money, which stems from the convenience factor as a means for exchange, and/or its value hoarding nature. When either condition (1) and/or (2) threatens the repayment ability of the government, individuals regard such a situation as the bankruptcy of the government. Individuals rush to the goods market and the price level hikes. This reduces the purchasing power of the old generation and the government whose income is fixed in the nominal term, and hence, aggregate demand decreases. Potential excess supply emerges. Thus, the economy falls into a serious stagnation. In addition, the young generation rationally expects that the economy would adapt to such a devastating situation, and that the *equilibrium* future price level would continue to be high clearing the potential excess supply. Thus, lack of belief in the intrinsic value of money provokes stagflation.

To summarize, there is a critical limit in the radical QE monetary policy. The critical point is determined by whether conditions (1) and/or (2) are satisfied or not. It should be noted that hyperinflation is a kind of stagflation in the sense that economic stagnation and rapid price increase coexist. As discussed above, lack of belief in the intrinsic value of money is persistent once it is generated. This is the reason why prudent management is the most important virtue for traditional and conservative financial institutions. This still seems to be a conventional wisdom today's the current financial institutions.

References

Bruno, Mickle and Sachs, Jeffery (1985). *Economics of Worldwide Stagflation*, Cambridge Massachusetts Harvard University Press.

Byrne, David M., Reinsdorf, Marshall B., Fernald, John G.. (2016). Does the United States have a Productivity Slowdown or a Measurement Problem? Federal Reserve Bank of San Francisco Working Paper, 2016-03.
http://www.frbsf.org/economic-research/publications/workingpapers/wp2016-03.pdf

Christensen,Jens (2009). Inflation Expectations and the Risk of Deflation, *FRESF* Economic Letter, 2009-34.
http://www.frbsf.org/economic-research/publications/economic-letter/2009/november/inflation-expectations-risk-deflation/

ECB Economic Bulletin, Issue 2 / 2016 – Box 1 (2016). The Slowdown in US Labour Productivity Growth – Stylised Facts and Economic Implications.
https://www.ecb.europa.eu/pub/pdf/other/eb201602_focus01.en.pdf?251945eddd1eeb95a2a7ba99c6e11ca9

Galli, J. (2008). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*, Princeton, New Jersey, Princeton University Press ,

Lucas, Robert E., (1972). Expectations and the Neutrality of Money, Journal of Economic Theory 4, 103-124.

Otaki, Masayuki. (2007). The Extended Keynesian Cross and the Welfare Improving Fiscal Policy, Economics Letters 96, 23-29.

Otaki, Masayuki (2009). A Microeconomic Foundation of the Full-Employment Policy. Economics Letters, 102, 1-3.

Otaki, Masayuki (2015). Keynesian Economics and Price Theory: Re-orientation of a Theory of Monetary Economy, Tokyo, Japan, Springer.

Piazza, Roberto, Deflation Expectations and Japan's Lost Decade (June 25, 2015). Bank of Italy Occasional Paper No. 274.
http://dx.doi.org/10.2139/ssrn.2649915

Year	Labor Productivity Progress (%)	Inflation Rate (%)
2001	1,7	3.6
2002	1.7	2.7
2003	2.3	2.4
2004	2.2	2.6
2005	1.6	2.6
2006	1.5	2.5
2007	1.4	3.6
2008	-0.1	0.51
2009	0.3	1.8
2010	1.8	2.9
2011	1.3	2.2
2012	0.3	1.6
2013	1.1	1.7
2014	0.6	0.6
2015	0.9	1.1

Table 1: Labor Productivity Progress and Inflation Rate
Data Source: OECD Employment and Market Statistics

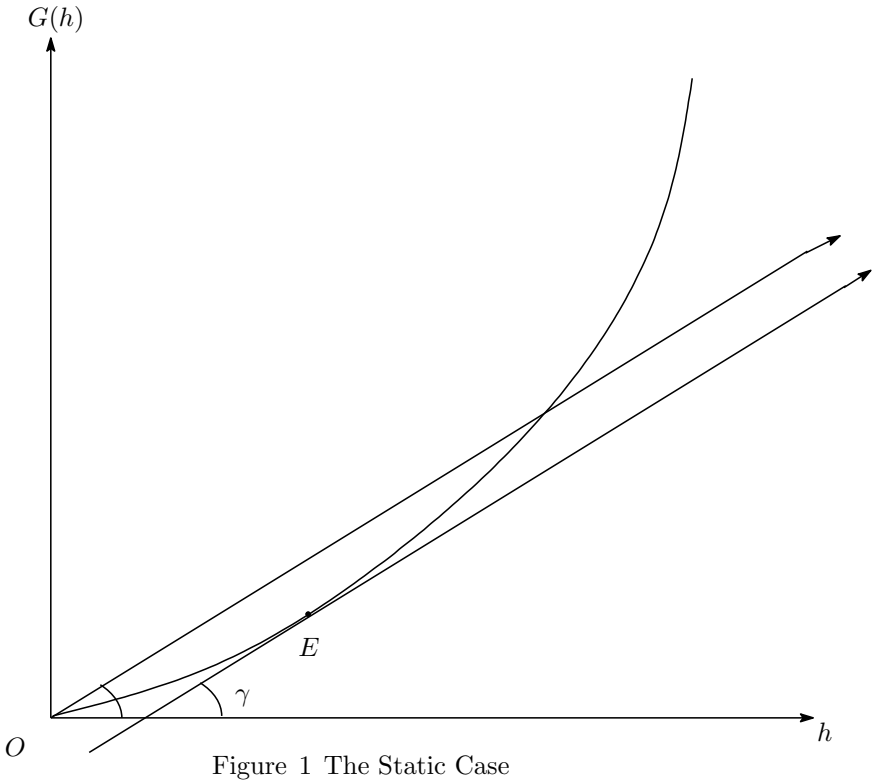

Figure 1 The Static Case

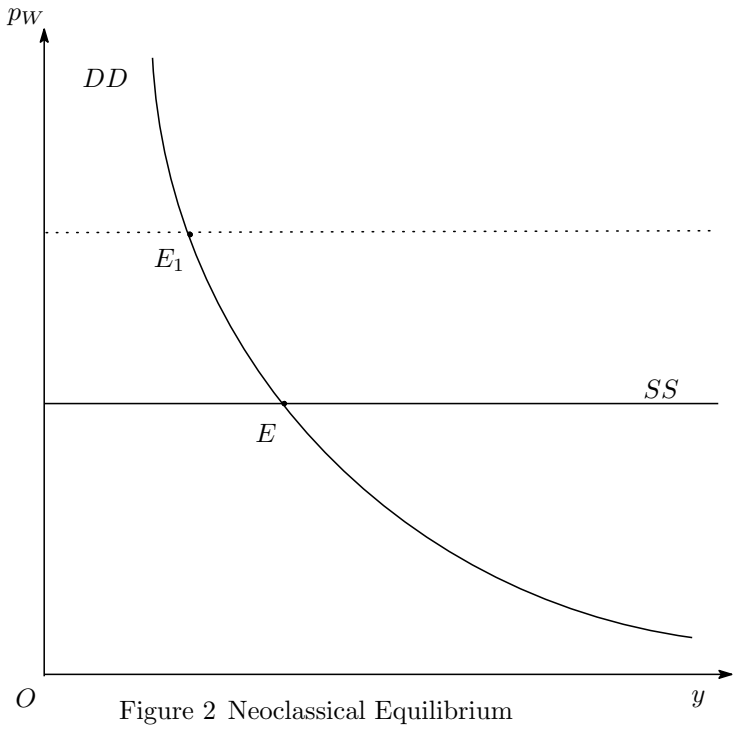

Figure 2 Neoclassical Equilibrium

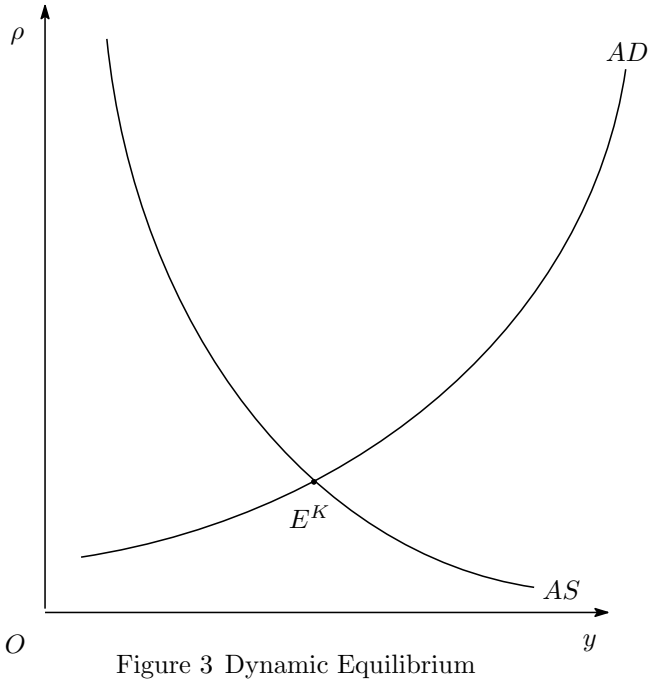

Figure 3 Dynamic Equilibrium

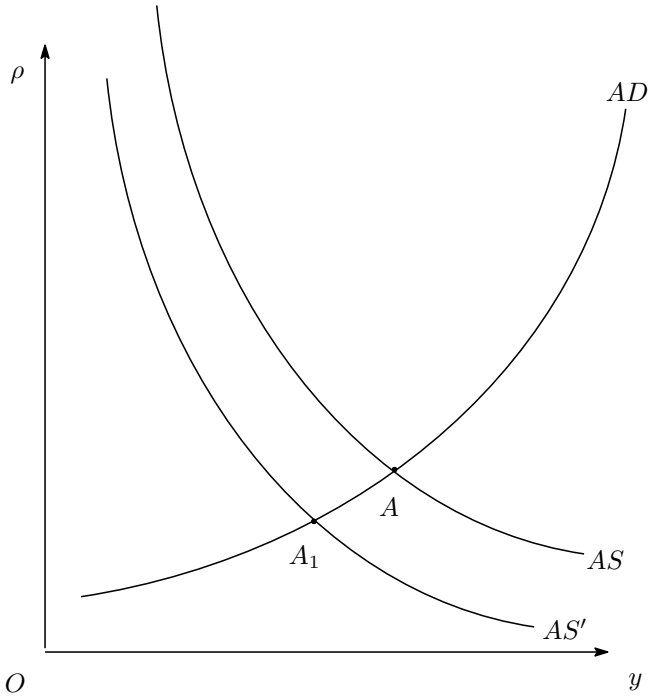

Figure 4 Productivity Slowdown and Disinflation

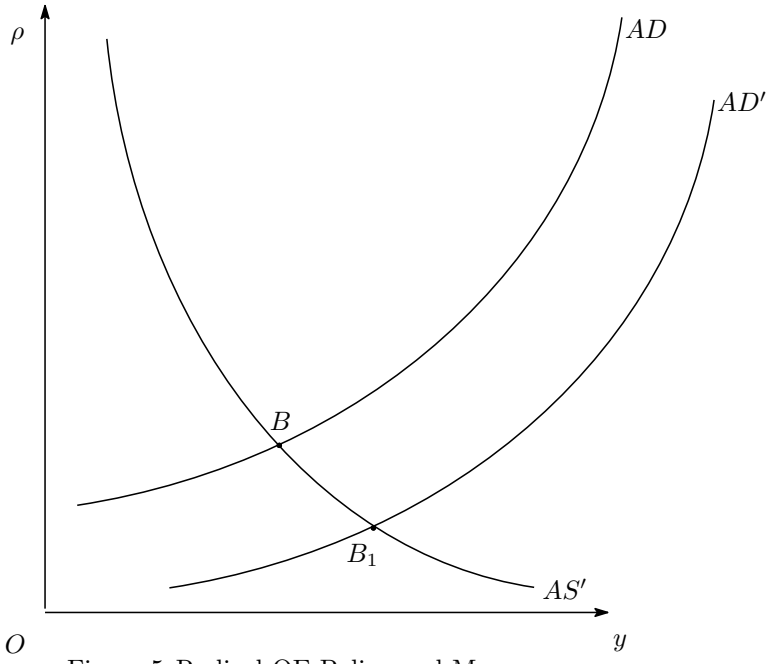

Figure 5 Radical QE Policy and Macroeconomy

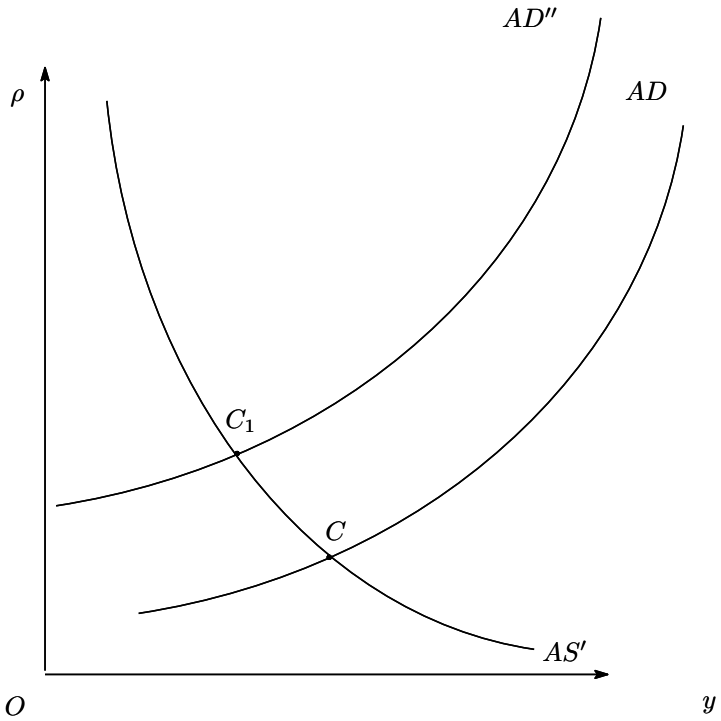

Figure 6 Stagflation by Disbelief in the Value of Money