# Interaction between Business Cycles and Economic Growth

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*In the aftermath of the recent global financial crisis, advanced economies have faced sluggish recoveries or long-lasting economic slowdowns. This experience has challenged the conventional dichotomy of business cycles and economic growth, which has long been central to macroeconomic analysis. Against this backdrop, we review the literature regarding the relationship between business cycles and economic growth. This study consists of three parts. First, we provide basic ideas about the relationship between business cycles and economic growth, and a simple empirical analysis on economic growth rates in advanced economies. Second, we survey studies exploring the effects of business cycles on economic growth. Specifically, we focus on hysteresis effects caused by labor market structure, firm activity, and fiscal policy. Third, we review the literature on the effects of economic growth on business cycles, through mechanisms such as technological progress and population aging.*

Keywords: Business cycles; Economic growth; Hysteresis
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## I. Introduction

Since the global financial crisis (hereafter GFC) in the late 2000s, advanced economies have grown substantially slower when compared with their pre-crisis trends. Prolonged weak growth observed in these economies after the GFC has stirred up academic debates about what caused this severe economic slump. A well-known example of these arguments is the revival of the term "secular stagnation", initially proposed in the 1930s.[1] Macroeconomists and policymakers have expressed a variety of theories on this issue from both the demand- and supply-sides stories. A popular demand-side story is that the lack of demand since the crisis has reduced the pace of long-term economic growth. On the supply side, factors such as low innovation and dramatic demographic changes have had an adverse effect on the long-term economic trend.

This paper aims to provide new insights to disentangle the debate, focusing on the relationship between short-run business cycles and the middle-to-long-run trend of economic growth. In reality, the dichotomy of business cycles and economic growth has been central to modern macroeconomic analysis. However, considering the existing debates, it is clear that we should go beyond the dichotomy and further explore the relationship between business cycles and economic growth.[2]

The paper is organized as follows. Section II gives the literature review and goes over some simple empirical exercises to show basic ideas and facts on the relationship between business cycles and economic growth. Sections III and IV respectively survey the literature looking at the effect of business cycles on economic growth, and conversely, the effect of economic growth on business cycles. Section V concludes with suggestions for future research.

## II. The Dichotomy of Business Cycles and Economic Growth

This section begins by exploring the conventional dichotomy of business cycles and economic growth, which has long been central to macroeconomic analysis. We then examine the validity of the dichotomy through a simple empirical analysis.

### A. Relationship between Business Cycles and Economic Growth

Standard macroeconomics textbooks such as Mankiw (2015) and Jones (2017) advocate the view that economic growth trends reflect a variety of long-term (supply-side) factors such as demographic trends, technological progress, and capital accumulation. By contrast, business cycles, which are fluctuations around a given trend, are supposed to reflect short-run (mainly demand-side) economic variations.[3] This conventional wis-

1. See Summers (2014), Gordon (2014), and Nakano and Kato (2017) for the secular stagnation theory.
2. Goodwin (1967) is an early study on the dichotomy of business cycles and economic growth. The dichotomy had become a mainstream of macroeconomic analysis by the middle of the 1970s. However, a growing body of research has called for the reexamination of its relevance in recent years. See Faust and Leeper (2015) and Nakaso (2016).
3. Hodrick and Prescott (1997) define a cyclical component of aggregate economic fluctuations as part of the fluctuations which is not explained by the neo-classical growth theory. Blanchard and Quah (1989) also present shock identification strategy with long-run restrictions in the time-series model, based on the idea of the dichotomy.

dom is known as the "dichotomy of business cycles and economic growth." First built upon the neoclassical synthesis of Samuelson's seminal works, this dichotomy has long influenced macroeconomic analysis.[4] According to the dichotomy of business cycles and economic growth, demand factors only influence business cycles and never middle to long-term economic growth, which supply-side factors dominate. This implies that total demand and supply are determined independently in the long run.[5] If the dichotomy correctly describes the actual economy, we can disentangle business cycles and economic growth, because they are mutually independent.

To see the empirical relevance of the dichotomy, Figure 1 shows the level of real GDP and its trend since 1970 in Japan, the United States, high-income European countries (France, Germany, and the United Kingdom), and southern European countries (Greece, Italy, Portugal, and Spain). In the United States and European countries, the real GDP broadly moves around a single stable trend.[6] That the stable trend is observed supports the view that business cycles and economic growth can be analyzed independently. However, we also find that the real GDP in these countries fails to return to the trend after falling by a historically large amount during the GFC.[7] Moreover, Japan seems to experience a flattening of the trend growth around 1992, which roughly corresponds to the beginning of the so-called Lost Decades after the burst of the Japanese asset price bubble in the late 1980s.

As shown in Figure 1, advanced economies tend to follow a lower path below its pre-crisis trend, after they experience large negative shocks in the form of the burst of asset price bubble and financial crisis. This suggests that it may be appropriate to assume a certain interaction between business cycles and economic growth rather than considering them to be in a conventional dichotomy.

When we consider interaction between business cycles and economic growth, we need to distinguish two causal relationships. The first causal relationship is an effect of business cycles on economic growth. Often referred to as the "hysteresis effect" or simply "hysteresis" in economics, this causal relationship has its origins in physics.[8] In physics, the term refers to a situation in which a variable depends on past shocks as well as current shocks. Hysteresis indicates that a temporary shock can have a sustained impact on a variable. In this study, we define the term hysteresis as an effect of a temporary change in aggregate demand on the trend of economic growth.[9]

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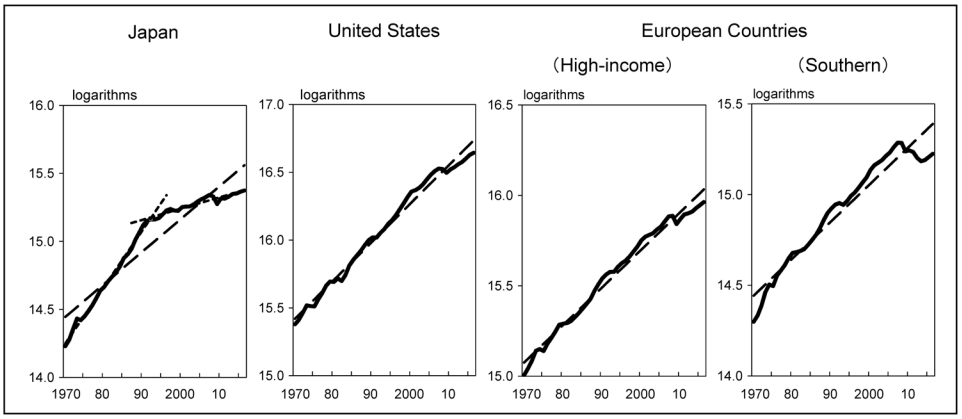
4. Major textbooks of economics including Mankiw (2015) and Jones (2017) explain business cycles and economic growth in separate sections.
5. The dichotomy traces its roots to the natural rate of unemployment hypothesis put forward by Friedman (1968) and Phelps (1968).
6. We apply the Bai-Perron breakpoint test to rates of annual real GDP growth over the period from 1970 to 2016. The results show a break in trends only in Japan for 1992. Note that results of trend-cycle decomposition, and thus their implications, may vary among methods of the decomposition. See Iiboshi (2011) for the literature on methodologies of trend-cycle decomposition.
7. If data are further accumulated in the future, structural changes in the trend might also be detected in the other countries considered.
8. After the GFC, an increasing number of studies have used the term hysteresis as the effect of slowdown in aggregate demand on economic growth. See Blanchard, Cerutti, and Summers (2015) for an example of such studies.
9. In a textbook discussion, the term hysteresis is used to illustrate a positive and prolonged impact of a temporary shock to the economy. In this study, the term is intended to cover both positive and negative impacts of temporary shocks.

**Figure 1 Real GDP and Its Trends in Selected Countries**




Note: Bold solid lines plot the level of real GDP for each country or region in logarithms, and thin dashed lines plot its linear trend estimated over the period 1971–2016. For Japan, the steeper thin dotted line shows the linear trend of real GDP estimated over the period 1971–1992, and the flatter dotted line shows the trend estimated over the period 1992–2016.

Source: OECD.

The second causal relationship is an effect of economic growth on business cycles. Potential growth is thought to be a proxy of the trend of economic growth. It is the growth rate of "average supply capacity of the economy (potential output)" smoothed out for business cycles. Potential growth rate is broken down into four elements: trend growth rates of employment, hours worked, capital stock, and productivity (Total Factor Productivity, TFP hereafter). Figure 2 plots potential growth rates as estimated by the Bank of Japan staff.[10] To understand the effect of economic growth on business cycles, it is essential to examine how these four elements influence real economic activities such as consumption, investment, and aggregate demand.

## B. Empirical Analysis

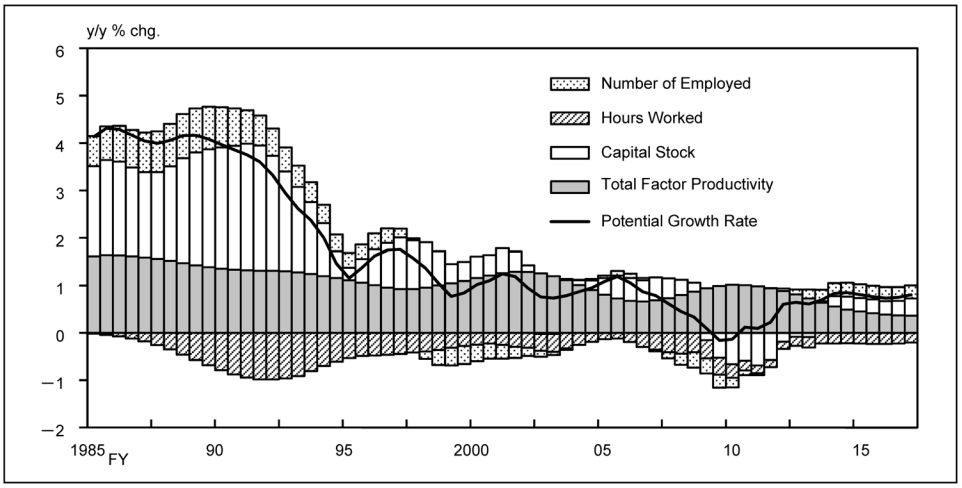
In this subsection, we conduct a simple empirical analysis on the relationship between business cycles and economic growth. We examine the hysteresis effect by testing whether a short-lived shock generates a long-run negative impact on the level of output, following the approach employed by Cerra and Saxena (2008).[11] Specifically, we estimate using the following panel VAR model:

$$g_{i,t} = a_i + \sum_{j=1}^{4} \beta_j \cdot g_{i,t-j} + \sum_{s=0}^{4} \delta_s \cdot D_{i,t-s} + \varepsilon_{i,t}\,, \tag{1}$$

where $g_{i,t}$ is the growth rate of real GDP per capita of the country $i$ at time $t$, and $D_{i,t}$ is a dummy variable which takes one in recession and zero otherwise.[12] In estimation,

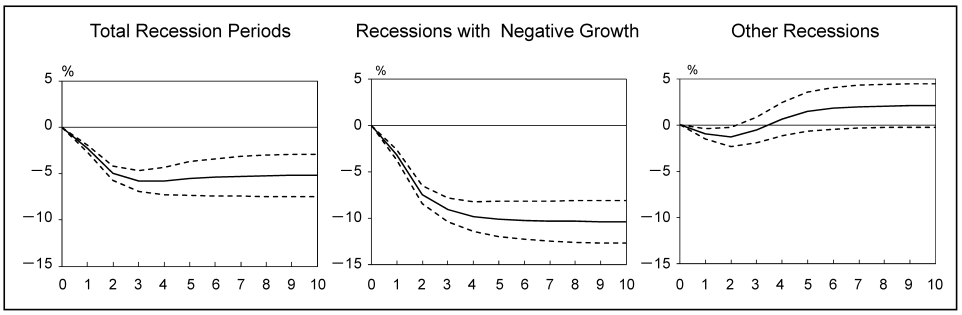
10. See Kawamoto, Ozaki, Kato, and Maehashi (2017) for the methodology of measuring the potential growth rate illustrated in Figure 2.
11. Cerra and Saxena (2008) investigate impacts of financial and political crises on economic growth.
12. We construct the recession dummy referring to the monthly Composite Leading Indicators (hereafter CLIs) constructed by the OECD. To be precise, the dummy takes one if the most recent past year contains a CLI-

**Figure 2 Potential Output Growth Rate**




Note: The Bank of Japan staff estimates. Figures for the first half of fiscal 2017 are those for 2017/Q2.
Sources: Cabinet Office; Bank of Japan; Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Ministry of Economy, Trade and Industry; Research Institute of Economy, Trade and Industry.

**Figure 3 Responses of Output Growth to a Recessionary Shock**




Note: Dashed lines exhibit 95 percent confidence intervals.
Source: Authors' estimation.

we use the GDP data from 33 OECD countries over the period from 1960 to 2016.

Figure 3 plots the estimated impulse-response functions to recession with 95 percent confidence intervals.

The recessionary shock has a negative effect on the economic growth rate which continues for more than ten years. The result of the simple empirical exercise suggests the existence of hysteresis, that is, that business cycles can exert a significant effect on economic growth. Although a recessionary shock is temporary, it tends to place prolonged downward pressure on economic growth.[13] The impact of recessions seems

dated peak.

13. If there is no hysteresis, the response of the economic growth rate to a recessionary shock eventually turns out to be positive. Hence, with the estimation results, we can conclude that such shocks do exert hysteresis effects on economic growth. We also note that the observed persistent response to the shock reveals a possible downward shift of the trend of economic growth. It suggests the presence of very strong hysteresis.

to be strengthened when the shock is large (as is the case of experiencing negative growth in Figure 3).

Other recent studies also show empirical evidence of the hysteresis effect based on different data sets and methodologies. Blanchard, Cerutti, and Summers (2015) measure gaps between post-recession output and the corresponding pre-recession trend in 23 advanced economies from 1960 to 2014.[14] They report negative average gaps in more than two thirds of the recessions over the period. Ball (2014) evaluates the impacts of the GFC on actual and potential output in 23 OECD countries. He shows that the level of potential output has plummeted since the crisis, dropping by 8.4 percent on average. The size of the decrease in potential output is almost as large as the decline in actual output over the same period. Using changes in trend output as a proxy of changes in potential output, Haltmaier (2012) studies relationships between the length and depth of recessions and corresponding changes in potential output. Examining output data from 40 countries, he finds that a deeper (longer) recession decreases potential output by a larger amount in advanced (emerging) countries.

In subsequent sections, we will review literature on the mechanism generating the effects of business cycles on economic growth.

## III. The Effects of Business Cycles on Economic Growth: Hysteresis

In Section II, we provided empirical evidence suggesting the presence of hysteresis, namely, a temporary shock to aggregate demand can have a long-lasting downward effect on economic growth. This section subsequently examines factors that generate hysteresis effects, particularly those arising from labor market structure, firms' activity, and fiscal policy.[15]

### A. Hysteresis in Labor Markets

As mentioned above, macroeconomic hysteresis is the long-lasting effect of a temporary shock on the economy. A number of studies have attempted to describe the persistent high unemployment rate in European countries in the 1980s as an effect of hysteresis. In the following, we look at three mechanisms that can generate hysteresis in labor markets, namely, insider-outsider relationships, loss of human capital, and a weak incentive for job search.[16] As Pissarides (1992) points out, hysteresis effects caused by these labor market structures can explain persistent macroeconomic fluctuations.

#### 1. Insider-outsider relationships

Blanchard and Summers (1986) provide an explanation of persistency in unemployment, focusing on the labor market segmentation between employed (insiders) and unemployed workers (outsiders). Once employed, workers become insiders who have the benefit of membership, which guarantees them job protection and allows them to participate in the wage-bargaining process. In the presence of such membership,

14. Specifically, they measure the gaps averaged over three to seven years after troughs.
15. Baldwin (1988) and Baldwin and Krugman (1989) argue that sunk costs on the entry-exit decisions of firms can generate hysteresis in the context of international trade.
16. Kuroda-Nakada (2001) provides a survey on hysteresis caused by labor market frictions.

wages are set in favor of insiders. Accordingly, the wage-bargaining process cannot eliminate slack in the labor market. If a short-lived shock decreases employment in the insider-outsider labor market, the level of employment will not be restored and high unemployment will continue on even after the shock vanishes.

In the insider-outsider labor markets, wages tend to exceed that of the marginal product of labor. According to Lindbeck and Snower (1986), wages can be above marginal product of labor because of the strong bargaining power of insiders in wage setting (e.g., the presence of unions). The deviation between wages and marginal product of labor can also reflect the incentive for employers to retain insiders, as they take into account of the costs of hiring, training, and firing workers.

**2. Loss of human capital**

Pissarides (1992) considers loss of human capital as a driving force of hysteresis in labor markets. He constructs a model of job search in which unemployed job-seekers and employers seeking workers co-exist. An important assumption in the model is that workers' skills depreciate during periods of unemployment; in other words, unemployment leads to a loss of human capital. This assumption is the key to generating hysteresis in the model. To understand the mechanism, consider a temporary shock which decreases firm profitability. The shock increases the duration of unemployment by reducing the labor demand of firms. Because the skill level of job seekers decreases as a result of the longer period of unemployment, they become less attractive to firms. As a result, the level of labor demand is not restored even after profitability is recovered. Accordingly, there are fewer workers in the labor market compared to the pre-shock period, and the efficiency of matching technologies decreases. This situation is termed a thin market externality. Since loss in the efficiency of matching technologies works as an externality, the unemployment duration of already unemployed workers is further prolonged. This leads to persistent declines in human capital and job offers. To summarize, the loss of human capital as a result of unemployment generates hysteresis. Unemployment remains persistently high even after the initial shock which causes the reduction in employment disappears.

Diamond (1982) formally proves the existence of multiple equilibria, focusing on the externality of expectation. In his model, an agent will intensify (weaken) search activity if he or she expects the others to be more (less) active on job search. The resulting probability of matching jobs to workers increases (decreases).

**3. Weaker incentive for job search**

Ljungqvist and Sargent (1998) explain the hysteresis effects of unemployment via the weaker incentive to conduct a job search. In their model, workers become stochastically unemployed with a common probability. Unemployed workers receive unemployment benefits, and engage in costly job search. For an unemployed worker, a more intensive job search (that is, a job search which is more costly) leads to a higher probability of finding a job. The problem for unemployed workers is to choose an optimal level of job search intensity which maximizes the sum of expected returns from finding a job and from being unemployed. A high level of unemployment benefits corresponds to a low probability of finding a job, because it weakens the incentive for workers to engage in a costly job search. Moreover, the amount of benefits paid to an unemployed worker is supposed to depend on the worker's past wage and skill level. This means

that a worker with higher skills and a longer tenure in a specific industry would usually receive higher unemployment benefits, thus weakening the incentive to conduct an intensive job search. Ljungqvist and Sargent (1998) use this framework to explain how a large shock requiring labor reallocation, such as intense global competition, results in high and persistent unemployment.

## 4. Empirical evidence

Hysteresis in labor markets has been considered as a popular explanation for high and persistent unemployment. The literature on hysteresis proposes several empirical approaches to examine its effects on unemployment. One approach is to analyze patterns of unemployment rates over time. Camarero and Tamarit (2004), Brunello (1990), and Teruyama and Toda (1997) suggest that the strong serial correlation or non-stationarity of unemployment rates in Europe and Japan suggests the presence of hysteresis in those labor markets.[17] Ohta, Genda, and Teruyama (2008) find that the responses of unemployment to macroeconomic shocks are substantially persistent in Japan, particularly during the high unemployment period from the late 1990s to the mid-2000s.[18]

An alternative approach is to examine whether current slack in the aggregate labor market influences individual worker's employment conditions five to ten years ahead. This effect, often referred to as the cohort effect, can also be classified as a type of hysteresis effect. Genda, Kondo, and Ohta (2010) study the relationship between the economic conditions that a worker faces at labor market entry and his/her resulting employment status and earnings. They show that weak labor demand at the time of workers' labor market entry has a negative impact on their employment probability and real income. This is particularly the case for less-educated workers. Moreover, these impacts are substantially larger in Japan compared with the United States, where they only have a small impact. Genda, Kondo, and Ohta (2010) discuss that the results may reflect Japan's conventional labor market structure.[19, 20] The typical features of which are: i) the difficulty for non-regular workers in transition to become regular workers, ii) low probability of matching jobs to workers due to the thin labor market, and iii) persistently low labor productivity in the sector which provides workers less opportunities for human capital accumulation. Yokoyama, Higa, and Kawaguchi (2018) conduct empirical analysis on the relationship of the Japan-specific labor market structure and hysteresis effects. They quantify the relationship by studying labor market responses

17. Ball (2009) points out that the unemployment rate and non-accelerating inflation rate of unemployment (hereafter NAIRU) move together in the presence of hysteresis in labor markets. The NAIRU is supposed to reflect structural developments of the economy. If hysteresis actually exists, a decline in the actual unemployment rate can decrease the NAIRU. Using the data from OECD countries, he shows that they have been broadly moving in the same direction since 1980.
18. Galí (2015) shows that the introduction of insider-outsider labor markets into the New Keynesian model can improve its performance in describing European nominal wage dynamics.
19. Oreopoulos, Wachter, and Heisz (2006) conduct a similar analysis on the United States, and find that the labor market conditions during a job search period do not have a significant impact on employment condition over the subsequent period. By contrast, Kondo (2007) provides opposing empirical evidence using Japan's data, estimating the probability that regular workers can continue to be regular workers in the future. The result shows that the probability is significantly higher for those who enter the labor market as regular workers than those who do not.
20. Ohtaki (1994) and Kuroda-Nakada (2001) suggest the possibility of Japan's conventional labor market structure generating hysteresis via the mechanism of the insider-outsider theory. They argue that high training costs and the strict legislation on dismissing regular workers in Japan can cause hysteresis effects.

to exchange rate shocks.

**B. Hysteresis Arising from Firm Activity**

Other studies argue that firm's activity on productivity improvement can explain the linkage between business cycles and economic growth. This subsection reviews those studies, focusing on whether expansions (recessions) are associated with the acceleration (deceleration) of productivity growth in medium term.[21] If long-term productivity is pro-cyclical, a recessionary shock tends to shift the trend of economic growth down, just as with hysteresis in labor markets. In contrast, if long-term productivity is counter-cyclical, a recessionary shock tends to shift the trend of economic growth up.

**1. Pro-cyclicality of long-term productivity**

Let us look back through the developments of business cycle theories to the 1980s. Nelson and Plosser (1982) report the presence of non-stationary stochastic trends in the real GDP of the United States. This means that real output never returns to its past trend once a shock hits the economy. Against this backdrop, real business cycle (hereafter RBC) models pioneered by Kydland and Prescott (1982) introduce stochastic technology shocks to neo-classical economic growth models. The RBC theory attempts to explain dynamics of output in a stochastic trend process. In this sense, RBC models pursue integration of economic growth and business cycles. However, a standard RBC model argues that exogenous technology shock can explain stochastic trend of the economy, but it does not study how the change of trends arise endogenously.

**a. Endogenous technological progress and business cycles**

The mechanism of endogenous technological progress can explain persistent feature of macroeconomic variables, i.e., how a temporary shock to output causes a long-lasting trend in the level of output. In the mechanism, technological progress is determined by an optimal choice of economic agents rather than exogenous technology shocks. The literature on endogenous technological progress has evolved throughout the development of endogenous growth theory. Early examples of the literature are "learning-by-doing" (Arrow [1962] and Stokey [1988]) and "endogenous R&D activities" (Romer [1990] and Grossman and Helpman [1991]). These works focus mainly on economic growth trends, and not on business cycles. In recent works, some studies extend this framework to analyze co-movements between business cycles and economic growth. The model of Stadler (1990) shows how endogenous technological progress generates economic persistence.[22] In the model, the production function depends on labor input and technology. The model incorporates a learning-by-doing process, in which an increase in the past labor input and labor productivity raises the current level of

21. This section is largely based on Aghion and Howitt (1998).
22. Shleifer (1986) and Barlevy (2007) also study the relationship between business cycles and innovation including R&D activities. Shleifer (1986) constructs a model to describe firms' optimal choice of innovation to maximize the sequence of future profits. In the model, firms conduct innovation activities if they expect economic expansions in the near future. If individual firms expect future expansions, they intensify innovation activities. Accordingly aggregate demand increases. Barlevy (2007) considers a risk of technology imitation by rivals. Since newly invented technologies are quickly imitated, innovation firms choose the degree of innovation activities to maximize current profits rather than future profits. Consequently, firms tend to conduct R&D activities in expansions when they expect higher profits.

technology.

$$Output = f(technology,\ labor\ input,\ productivity\ shock),$$
$$Technology = g(past\ technology,\ past\ productivity,\ past\ labor\ input). \quad (2)$$

Having labor supply and money demand functions with an assumption of the profit maximization of firms to optimize labor demand, the equilibrium level of aggregate output becomes:

$$\begin{aligned} &Equilibrium\ Output \\ &\quad = current\ productivity\ shock \\ &\qquad + accumulated\ impacts\ of\ past\ productivity\ shocks. \end{aligned} \quad (3)$$

Aggregate output levels reflect the current temporary productivity shock and a series of past productivity shocks which come from the learning-by-doing process.[23] A short-lived shock can cause a permanent shift in aggregate output level under the endogenous technological progress framework.

Mechanism of endogenous technological progress through research and development (hereafter R&D) can account also for the linkage between business cycles and economic growth. Comin and Gertler (2006) construct a formal model to describe the mechanism. They extend the model of Romer (1990) by distinguishing between the innovation and adoption of technologies in the R&D process. In their model, business cycles impact both on the innovation and adoption processes through the following mechanism. Firms increase their productivity in two steps, namely, i) accumulating their stock of innovation technologies through R&D activities and ii) adopting invented technologies into their products. In the second step, higher expenditure on the adoption of new technologies makes them more successful. Moreover, the expected return from adoption expenditure is higher in expansions than in recessions, because the new products will be sold more in expansions. Consequently, adoption expenditure comoves aggregate demand. Similarly, the R&D activities in the first step move pro-cyclically, as they positively correlate with expected returns from the adoption of the technologies. In the end, a positive and temporary demand shock has a persistent positive impact on productivity over the medium term. Figure 4 illustrates the mechanism of technological progress suggested by Comin and Gertler (2006).

**b. Empirical evidence**

Recent studies empirically support the mechanism of endogenous technological progress. Cooper and Johri (2002) and Chang, Gomes, and Schorfheide (2002) prove that the learning-by-doing framework is important to describe the intrinsic persistence observed in economic variables. They also report that introducing the learning-by-doing mechanism improves the fit of dynamic stochastic general equilibrium (hereafter DSGE) models to data. As for endogenous R&D activities, Comin and Gertler (2006) report measured medium-term cycles (frequencies between 2 and 200 quarters) in the

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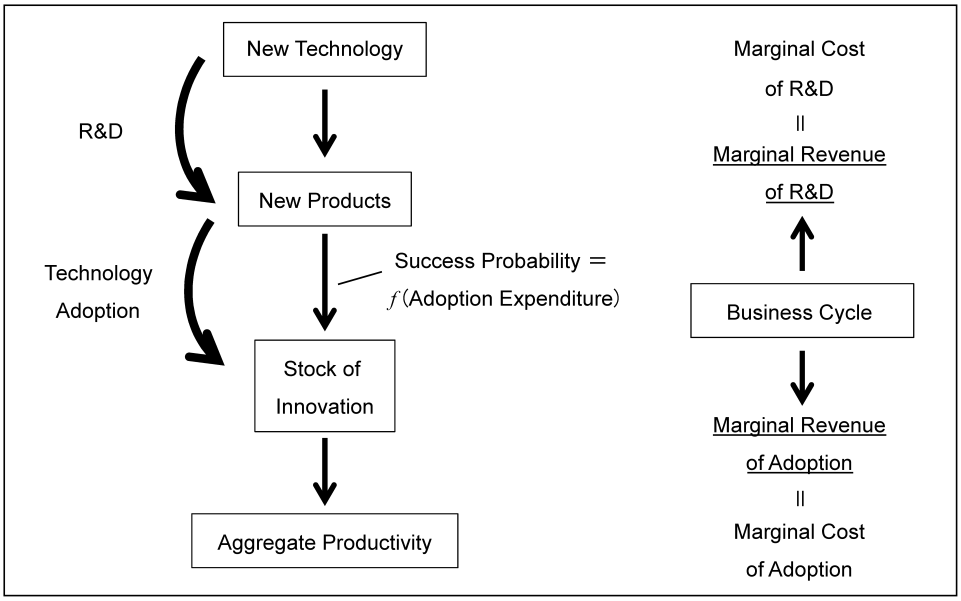
23. For simplicity, we ignore a permanent technology shock which appears in the original model of Stadler (1990).

**Figure 4 Endogenous Technological Progress and Business Cycles from Comin and Gertler (2006)**




U.S. data over the post-war period. In the medium-term cycle, both productivity and R&D activities move in a pro-cyclical manner. They conclude that the findings are consistent with their model incorporating endogenous R&D activities.[24]

A growing body of research shows that endogenous productivity can explain the experience of growth slowdowns associated with recessions in advanced economies. Anzoategui, Comin, Gertler, and Martinez (2017) study the productivity slowdown in the United States since the GFC. They estimate a standard DSGE model with the endogenous productivity of Comin and Gertler (2006). The model shows that a slowdown in technology adoption due to weak aggregate demand substantially and persistently decelerates productivity growth in the United States since the crisis. An exogenous decrease in TFP plays only a minor role.[25]

By contrast, Bianchi, Kung, and Morales (2014) construct a similar model to Anzoategui, Comin, Gertler, and Martinez (2017), though they conclude that the crisis has only limited impact on long-run growth. Their estimated model shows that a decline in marginal efficiency of physical investment (the degree of change in capital stock due to a unit of increase in investment) decelerates TFP growth. On the other hand, a decline in marginal efficiency of R&D investment has only a limited impact on TFP. According to Bianchi, Kung, and Morales (2014), marginal efficiency of R&D investment has been substantially reduced in the United States due to the burst of the dot-com bub-

24. Dosi, Fagiolo, and Roventini (2010) suggest that firms may intensify R&D activities in response to an increase in sales. They show that via this mechanism both technological progress and changes in aggregate demand have impacts on short-run and long-run economic dynamics. Moreover, lower entry costs on entrepreneurs lead to lower volatility in the short run and higher rate of economic growth in the long run.
25. Anzoategui, Comin, Gertler, and Martinez (2017) argue that the presence of zero lower bound of nominal interest rates may amplify the impact of productivity decline in response to a negative demand shock.

ble in 2001. This has already shifted the trend of TFP down. They conclude that the productivity slowdown since 2008 has only marginally decelerated TFP growth.

Comin (2008) applies the framework of Comin and Gertler (2006) to Japan's so-called Lost Decade in the 1990s. He argues that a slowdown in innovation and the adoption of innovations by Japanese firms accounts for the long recession which was caused by a transitory recessionary shock.

**c. Financial crisis and long-run growth**

An increasing number of studies consider financial shocks and their propagation as the main driving force of the slowdown since the GFC (Stock and Watson [2012] and Brunnermeier, Eisenbach, and Sannikov [2012]). For example, Guerron-Quintana and Jinnai (2015) construct a model with financial frictions and endogenous productivity. They prove that a negative shock to aggregate demand causes a decline in economic growth trend by making external financing difficult for entrepreneurs. Taking a similar approach, Ikeda and Kurozumi (2014) show that financial crises induce a long-term decline in the TFP by discouraging R&D activities because of the worsening financing environment.[26] Guerron-Quintana, Hirano, and Jinnai (2018) offer a new approach to describe the linkage between business cycles and economic growth. Instead of constructing a formal model on technological progress like Comin and Gertler (2006), they deliberately formulate the emergence and bursting of bubbles. Their analysis suggests that the mechanism of bubbles plays a central role in the relationship between business cycles and long-run economic growth.

Using models with financial intermediaries, Christiano, Motto, and Rostagno (2014) and other related studies highlight the role of idiosyncratic risks (productivity shocks) in economic dynamics. Aoki, Nirei, and Yamana (2018) construct a DSGE model with heterogeneous households to analyze the impacts of policies which facilitate household risk-taking on income distribution and economic growth.

**2. Counter-cyclicality of long-term productivity**

Counter-cyclicality of long-term productivity implies that long-run trend of economic growth is likely to rise rather than fall during recessions. In other words, there is a trade-off where the impacts of a recession on the economy are negative in the short run but positive in the long run. The literature on counter-cyclical productivity growth considers the opportunity costs for firms as an important factor which goes to explain the trade-off. In the following, we review the studies which examine the opportunity costs of productivity-improving activities, such as capital investments and entry-exit choices by firms.[27]

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26. They suggest that, in this situation, output-stabilizing monetary policy improves social welfare compared to a standard monetary policy pursuing inflation stability.
27. These discussions focus on efficiency of resource allocation and long-term productivity. Using a standard economic model, Nakakuki, Otani, and Shiratsuka (2004) propose a mechanism in which inefficient resource allocation leads to the lower level of output which the economy can achieve. In the model, inefficient resource allocation makes the frontier of output shift inside, lowering the level of output. Okina and Shiratsuka (2004) discuss that Japan's economic slump in the 1990s may not be due to large cyclical factors but due to a large downward shift of the trend of economic growth. As potential factors influencing the shift of the trend, they document the large volatility of relative price of assets in unit of general price (distortions of relative prices over time) and dispersion of factor prices across sectors (cross-sectional distortions of relative prices).

**a. Business cycles and investment**

There is a vast literature on the cyclicality of the opportunity costs of productivity-improving activities. The studies particularly discuss whether firms carry out capital investment in expansions or in recessions. Hall (1991) considers the resource allocation of firms as a form of productivity-improving investment activities. He offers the concept of "organizational capital," which is defined as the efficient allocation of resources in an organization to improve long-run productivity. In his model, firms allocate labor between i) making products and ii) accumulation of organizational capital. Organizational capital deteriorates, as products and physical capital become outdated, workers age, and technologies become obsolete over time. Deterioration of organizational capital decreases the level of productivity. Hence, firms need investment in organizational capital to improve their productivity.

$$Output = f\,(organizational\ capital,\ labor\ input,\ physical\ capital)\,. \tag{4}$$

$$\begin{aligned} &An\ increment\ of\ organizational\ capital \\ &\quad = labor\ input\ allocated\ to\ organizational\ investment \\ &\qquad - depreciation\ of\ organizational\ capital. \end{aligned} \tag{5}$$

The opportunity cost of allocating workers to accumulate organizational capital is equal to potential profits missed by not allocating them to production activities in firms' optimal choice. Since the opportunity cost is lower in economic downturns, firms in a recession prefer to allocate resources to reorganizational activities instead of production.

Cooper and Haltiwanger (1993) focus on roles of machine replacement by firms in the relationship between production and capital investment. In their model, a firm's output depends on labor input and productivity of machines.

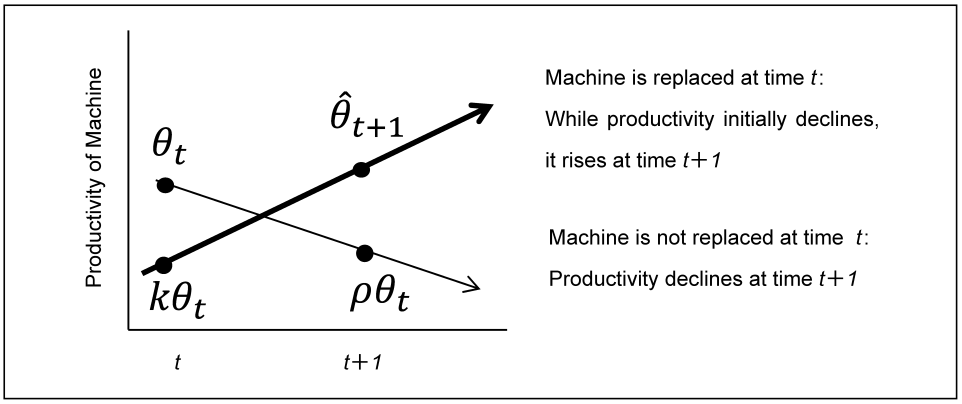
$$Output = labor\ input \times machine\ productivity. \tag{6}$$

In each period, firms choose either to maintain or to replace part of their machines. Machine replacement raises future productivity because new machines are more productive than those previously used. At the same time, firms pay a cost for machine replacement.

To understand a firm's choice, suppose the firm decides to keep using its machines. In this case, the future productivity ($\theta_{t+1}$) will decrease from the current level ($\theta_t$) as the machines depreciate at the rate of $\rho < 1$. By contrast, if the firm chooses machine replacement, the future productivity will increase at the expense of a decline in the current productivity due to the replacement cost ($k < 1$). The firm chooses machine replacement if it has a higher discounted present value compared to the case without machine replacement. Figure 5 illustrates the firm's choice.

Since the model assumes profits and aggregate demand synchronize as in Hall (1991), shocks to decrease productivity or aggregate demand facilitate machine replacement by reducing the opportunity cost. Consequently, machine replacement in-

**Figure 5 Productivity and Timing of Machine Replacement**




creases future productivity in recessions, and decreases it in expansions. In other words, machine replacement generates counter-cyclical productivity.[28]

**b. Business cycles and firm entry and exit**

Caballero and Hammour (1994) discuss the positive roles of recessions in technological progress via turnover of production units. The concept is that aggregate productivity improves in economic downturns as producers with lower productivity exit during this period. This sort of idea is often called as the Schumpeterian view of business cycles. Applying this framework to firm-level turnover, we explain how firms' entry and exit influences long-run productivity.[29] In the model of Caballero and Hammour (1994), the number of firms is determined by:

$$\begin{aligned} &\textit{An increase in the number of firms} \\ &\quad = \textit{number of entries} - \textit{number of exits} \\ &\quad\quad - \textit{number of firms fully depreciated.} \end{aligned} \tag{7}$$

The net increase in the number of firms consists of the number of firm entries, exits, and depreciations (failures). Firms exit the market when they reach the age of obsolescence. The age of obsolescence rises as aggregate demand increases, because an increase in demand makes older and less productive firms sufficiently profitable to run. In the model, firms are supposed to depreciate at a given rate. Since recessions encourage less productive firms to exit by reducing the obsolescence age, aggregate productivity rises in economic downturns. Caballero and Hammour (1994) call the positive effect of recessions a "cleansing effect."

On the other hand, they also argue a potential negative effect of recessions on aggregate productivity. The number of firm entries, the first term of the equation, is pro-

28. Cooper and Haltiwanger (1993) point out that machine replacement can be synchronized among firms due to its strategic complementarity (a firm receives larger gain from machine replacement as those of the other firms increase). If the synchronization materializes, the impact of a firm's machine replacement can spread over the economy.
29. To be precise, Caballero and Hammour (1994) study creation and destruction of production units. They conduct empirical analyses on the data of job creation and destruction which is supposed to reflect the dynamics of the creation and destruction of production units.

cyclical. Highly-productive firms may not be willing to enter the market in recessions, and vice versa. Hence, in recessions, slowdown in firm entries contributes to a decrease in aggregate productivity. Caballero and Hammour (1994) call this effect the "insulation effect." The negative insulation effect on productivity partly offsets the positive cleansing effect.[30, 31] An important implication of this theory is that the correlation between business cycles and economic growth depends on the cyclicality of firm entry and exit.

**c. Empirical evidence**

These theories spot the positive impacts of recessions on long-run productivity through turnover or reallocation of resources. Cooper and Haltiwanger (1993) and Caballero and Hammour (1994) provide empirical evidence as well as a theoretical framework. Both papers use the data of job creation and destruction as a proxy for the production units employed in their models.[32] Their empirical evidence supports the theoretical model's implication, that is, the difference in cyclicality between job creation and destruction affects the relationship between business cycles and economic growth.

In the 1990s the vast literature on the U.S. economy, including Blanchard and Diamond (1990) and Davis, Haltiwanger, and Schuh (1996), finds greater cyclicality and stronger persistence of job destruction over job creation. The results suggest aggregate productivity improvement through job destruction, that is, the presence of the cleansing effect, as well as the counter-cyclicality of long-run growth. By contrast, in the 2000s, a growing number of studies provide opposing empirical evidence from U.S. data, as they refine measurement methods and job destruction and creation data.[33] Hall (2005) considers the rate of job finding and separation as a measure of job creation and destruction. The job-finding rate is the probability of unemployed workers finding a job. He finds greater cyclicality of the job-finding rate compared to the job-separation rate, and concludes that the impact of job creation dominates in fluctuations of the unemployment rate. Shimer (2012) reaches a similar conclusion to Hall (2005). Examining employment flow data over the last 60 years, he reports that changes in the job-finding rate can explain a substantial part of changes in the unemployment rate. Shimer (2012) also shows that the explanatory power of the job-finding rate becomes greater if us-

30. Insulation effects literally means that slowdown in aggregate demand can insulate the economy from the cleansing effects. The literature discusses other factors which also diminish cleansing effects. For example, Barlevy (2002) suggests that the declining efficiency of job search for high productivity jobs in recessions may partially offset cleansing effects.
31. In the model, the marginal cost of a firm's entry is supposed to increase in response to a rise in the rate of entry as a result of congestion effects or other factors. Having the assumption, the model eliminates the possibility that insulation effects by firm entries fully offset cleansing effects by firm exits.
32. Caballero and Hammour (1994) provide empirical evidence from the data of labor flow on the stronger cyclicality of job destruction compared to that of job creation. They state that the result is consistent with their theory as well as the empirical findings of the previous studies. We note that the literature often captures job creation (destruction) via the data of replacement (scrap) of factories and machines.
33. In the 1990s, job creation (destruction) was measured by the number of firms increasing (decreasing) employment. Since the 2000s, the main measures have been changing to job-finding and separation rates. The job-finding (separation) rate is the probability of changing a worker's job status from unemployed (employed) to employed (unemployed). Compared to the new method, the conventional method tends to provide less accurate estimates on job creation and destruction. For example, the old measure of job creation consists of job-finding rate and the stock of unemployment. The latter tends to offset the impact of the former due to the difference in cyclicality between them. Shimer (2012) empirically shows the stronger cyclicality of the job-finding rate in comparison to the separation rate.

**Figure 6 Job Creation, Job Destruction, and Long-run Productivity**

| 1990s | 2000s |
|---|---|
| Blanchard and Diamond (1990)<br>Davis, Haltiwanger, and Schuh (1996) | Hall (2005)<br>Shimer (2012) |
| **Job destruction is more cyclical** | **Job creation is more cyclical** |

| | Destruction of less productive jobs | Creation of more productive jobs |
|---|---|---|
| **Expansions** | Decrease | Increase |
| **Recessions** | Increase | Decrease |
| **Productivity** | Counter-cyclical | Pro-cyclical |

ing data from the last 25 years. These findings suggest pro-cyclical job creation and thus the pro-cyclicality of long-run productivity. Figure 6 documents the relationships between job creation, job destruction, and long-run productivity.

The recent empirical findings suggest that the productivity of the United States has risen during expansions and fallen in recessions since the 2000s. However, we should note that in these studies the newly created jobs are presumably more productive and those jobs which are scrapped are less productive. Foster, Grim, and Haltiwanger (2014) evaluate the validity of the assumption by measuring firm-level TFP of the United States. Having the firm-level TFP data, they re-examine the cleansing effect by testing whether more productive firms tend to increase employment and less productive firms tend to exit. The results show a stronger cleansing effect in recessions. However, the effect has weakened since the GFC in the late 2000s, particularly during the period of the economic slump just after the GFC.

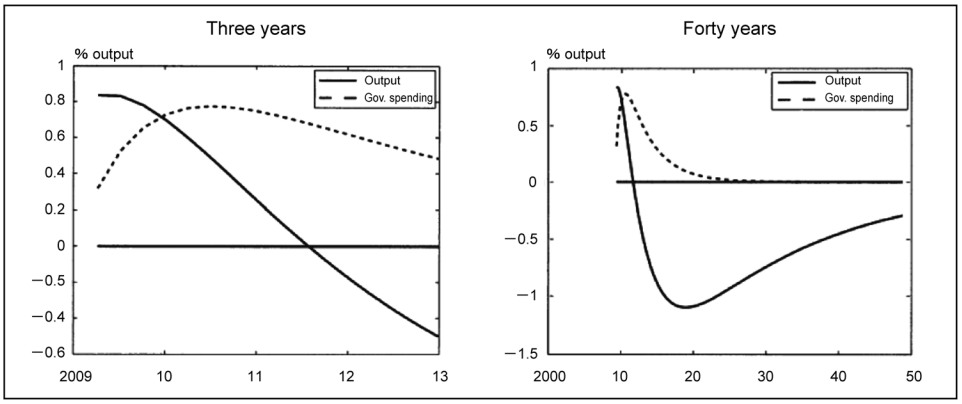
Other studies argue that resource reallocation from low to high productivity firms does not always facilitate economic growth in the United States. Hsieh and Klenow (2017) indicate that income inequality among firms suggests resource reallocation does not work. They also document that job creation by new firms does not significantly contribute to aggregate economic growth. Similarly, empirical studies on the Japanese economy do not seem to support the idea of productivity improvement by destruction of low productivity jobs. Inui, Kim, Kwon, and Fukao (2011) investigate the main force of the rise in Japan's TFP since the 1990s, and show that productivity improvement by existing firms substantially outweighs that of firm turnover.

To sum up, counter-cyclicality of productivity does not seem to always be empirically supported.

### C. Hysteresis Arising from Fiscal Policy

We have seen the mechanism which generates the linkage between business cycles and economic growth. Fiscal policies can also create such a linkage. In the wake of the fiscal stimulus packages launched in advanced economies after the GFC, a growing

**Figure 7 Long-run Effects of Fiscal Policy: Output and Government Spending**




Source: Uhlig (2010).

body of research re-examines the impacts of fiscal policy on economic growth. Looking at the U.S. fiscal stimulus of 2009, Uhlig (2010) proves theoretically that the initial impact of fiscal stimulus on output is positive while its long-run effect is negative. In his model, under the necessity of balancing the long-term fiscal budget, the government must compensate in the future for a current decrease in fiscal revenue by fiscal stimulus, for example, by increasing in tax rates. To demonstrate the impacts of fiscal stimulus, suppose the government puts in place a temporary cut of the income tax rate. Households would increase current labor supply, as they expect a future increase in the tax rate, initially increasing output. However, when the government eventually raises the tax rate to balance the fiscal budget, labor supply decreases and output persistently declines accordingly. Figure 7 plots the long-run effects of fiscal policy on output and government spending illustrated in Uhlig (2010).

Moreover, expansionary fiscal policy can crowd out private investment. Kitao (2010) and Drautzburg and Uhlig (2015) find that fiscal stimulus has a long and negative impact on output by reducing private investment. Fiscal expansions can also risk raising fears of future economic collapse, reducing long-term productivity. However, Auerbach and Gorodnichenko (2017) document empirical evidence that the long-term impact of unexpected fiscal expansions is limited. While such shocks increase the rate of the GDP growth in recessions, they seem to have no significant impact on long-term interest rates and the CDS spreads.

There may also be a positive correlation between government spending and long-term growth. Barro (1990) suggests a positive impact of fiscal stimulus via the accumulation of public capital. This implies that fiscal consolidation contributes to a decrease in long-term economic growth. Fatás and Summers (2017) discuss the possibility of a slowdown in economic growth due to fiscal consolidation based on results of panel data analysis for advanced economies.

To summarize, there is a variety of discussions on the linkage between fiscal policy and economic growth. Futagami and Konishi (2018) construct a model with public capital to analyze the impact of fiscal consolidation on economic growth. Using the model, they show that fiscal consolidation raises future economic growth rates by facilitating

the accumulation of public capital, because it makes more room for public investment. They also examine how impacts of fiscal consolidation on social welfare differ among policy measures, particularly between a fiscal expenditure cut and a tax rate rise.

## IV. The Effects of Economic Growth on Business Cycles

In Section III, we reviewed the effects of business cycles on economic growth. Section IV considers the reverse causality, namely, the impact of changes in economic growth on business cycles. We specifically review the literature on factors altering long-term economic growth and their impact on business cycles, including technological progress and demographic changes.

### A. Technological Progress

Technological progress is an important source of long-run economic growth because it creates a permanent upward shift of productivity. In this subsection, we look at a theory which argues that a gradual spread of technology causes temporary economic slowdown.[34]

This theory focuses on technology which has positive and permanent impacts on output and productivity across broad sectors. These types of technologies are collectively referred to as general purpose technologies (hereafter GPTs). Electricity and information technology are typical examples of GPTs. Jovanovic and Rousseau (2005) characterize a GPT as a pervasive technology that improves productivity and facilitates the creation of new products or production processes.[35] Helpman and Trajtenberg (1998) point to the possibility of a temporary recession occurring during the process of adopting GPTs. They model an economy with stochastic innovation and costly adoption of GPTs. An important assumption of the model is that the process of technology adoption cannot start until an innovation has been generated. When a GPT is finally innovated, the technology is spread over the economy in two phases. The first phase is to adopt the GPT into intermediate goods via the R&D process. In this phase, production activities slow down because part of the workforce is reallocated from production to adoption activities. This reduces productivity, real wage, and profitability. The second phase is to produce the final goods using the intermediate goods which embodies GPT. Accordingly, productivity, real wage, and profitability rise. Throughout two phases, we see that the GPT raises the rate of economic growth. The temporary economic slowdown due to the adoption of a GPT can be interpreted as a social cost to achieving higher growth.

In reality, GPTs are rarely invented. We note that the takeaway from the GPT models is not a direct illustration of the process of technological progress. Rather, it is that the adjustment cost of technology adoption can cause economic slowdown during transition to the long-run productivity resulting from the technology. Hornstein and Krusell

34. Aguiar and Gopinath (2007) compare characteristics of business cycles across countries, and show that shocks to the trend growth is a primary source of business fluctuations in the emerging economics, unlike in the developed economies.
35. Aghion and Howitt (1998) consider the GPT as a source of generating causality from economic growth to the business cycle.

(1996) argue that rapid technological progress may not always increase productivity. They indicate that it may have an adverse impact on productivity if skill-learning is costly or past experience does not help to run new machines.

**B. Demographic Changes**

Population aging is a common demographic change across advanced countries.[36] Aging can reduce economic growth through shrinkage of the aggregate labor force and a slowdown in technological progress. The latter is due to a decrease in the number of workers for R&D activities.[37]

Aging can also have an effect on business cycles; one potential factor is age-related heterogeneity in households. For example, population aging can alter aggregate demand if there is heterogeneity in the preference of consumers across ages.[38] Moreno-Galbis and Sopraseuth (2014) provide empirical evidence of demand shift due to population aging. They report that aging has increased demand for personal services in advanced economies in recent years. Katagiri (2012) shows that unemployment rates are likely to rise during aging-induced demand shift, because labor market frictions prevent the reallocation of labor force.[39] This suggests that shortage of goods and resulting economic slowdown are likely to occur in the transition to new demand structure.

Saito, Fueki, Fukunaga, and Yoneyama (2012) discuss a mechanism which generates insufficient supply in response to demand shift caused by population aging. With an estimated DSGE model of Japan's economy, they show such demand shift is likely to account for the deflationary pressure occurring since the 1990s. Aoki and Yoshikawa (1999) argue a related point to Saito, Fueki, Fukunaga, and Yoneyama (2012). They create the term "demand creating innovation" to describe a new technology which can be used to invent a good with a greater growth rate than that of existing goods. They emphasize that demand creating innovation drives economic growth permanently, because demand for old goods is eventually saturated.

In this subsection, we have seen short-run economic impacts of changes in growth

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36. In general, demographic changes are accompanied by shifts of age structure. The share of population which is older tends to rise when the total population declines. Sakura, Naganuma, Nishizaki, Hara, and Yamamoto (2012) document the impacts of demographic changes on long-term economic growth.
37. See Hirata (2012) for a literature survey on the relationship between demography and economic growth. He focuses on the nonrival nature of technologies, meaning multiple agents can utilize technologies. He states that, if being nonrival is a valid assumption, a country can raise its economic growth rate even if the population declines by importing advanced technologies from foreign countries.
38. There are studies suggesting population aging is likely to reduce the volatility of an economy. In this sense, changes in the economic trend affect business cycles. Jaimovich, Pruitt, and Siu (2013) theoretically prove that a technology shock increases the volatility of labor demand for younger workers by a larger amount than that of the demand for older workers. Since older workers have accumulated skills over time, they should have a stronger capital-skill complementarity than younger workers. Accordingly, the demand for older workers is less responsive to technology shocks. The findings of Jaimovich, Pruitt, and Siu (2013) support the empirical evidence that an economy with relatively young workers tends to face lower economic volatility. Jaimovich and Siu (2009) show that the demographic change in the United States accounts for from one fifth to one third of the decrease in the volatility of GDP since the middle of 1980s.
39. An increasing number of workers have been flowing into services industries (for example, medical services and insurance, enterprise services, and information services). Shioji (2013) argues that the shift may be attributed to changes in relative demand rather than cross-sectional differences in productivity. He points out that population aging has substantially stimulated the demand for medical services and insurance, but these industries do not hire many workers.

due to technological progress or demographic change. To summarize, the impact of economic growth on business cycles depends on economic frictions including adjustment costs and rigidities. Put differently, increasing resilience to changes in economic trend, such as technological progress and demographic change, may enable us to avoid an economic slump. This point has been discussed in the recent literature on the Japanese economy. For example, Nakamura, Kaihatsu, and Yagi (2018) argue that enhancing flexibility in workflows in response to technological progress is the key to increasing Japan's long-term productivity. Aoki, Hara and Koga (2017) point to the importance of a mutual relationship between firm's innovation and government's structural reform in technological progress. They suggest that a shift to a good equilibrium where the two factors coincide is essential to improve productivity.

### C. Expectations

Expectations regarding technological progress and demographic change can also influence the dynamics of aggregate demand.

To see the mechanism, suppose that agents expect a permanent rise in productivity induced by technological progress. This means that an upward shift in the economic growth trend is expected. Such expectations can facilitate private consumption and investment even before productivity actually rises. However, agents might eventually realize that they have been too optimistic about future productivity growth. In this case, they will revise their expectations of economic growth down and reduce consumption and investment. Consequently, the change in expectations generates business cycles. Beaudry and Portier (2004) and Blanchard, L'Huillier, and Lorenzoni (2013) study the role of expectations on productivity growth in U.S. business cycles using DSGE models. They document that consumption and investment increase under overly optimistic expectations, while they significantly decline when agents realize their overestimation of future productivity growth.[40]

In a similar vein, Katagiri (2012) shows that the underestimation of the pace of population aging has been working as a repetitive shock, decreasing aggregate demand. He also documents that downward revisions to the population forecast can affect the GDP, unemployment rate, and inflation rates both in the short run and long run.

In summary, business cycles are likely to reflect expectations of factors influencing growth, such as technological progress and population aging, because agents rely on expectations to make decisions regarding investment and consumption.

## V. Concluding Remarks

Since the GFC, advanced economies have faced sluggish recoveries or long-lasting economic slowdowns. This experience has challenged the conventional dichotomy of business cycles and economic growth, which has long been central to macroeconomic analysis. Accordingly, a growing body of research has reexamined linkages between business cycles and growth. This paper has reviewed the approaches and implications

40. Blanchard, L'Huillier, and Lorenzoni (2013) report their variance decomposition results to show that the forecast errors of productivity growth rates account for roughly half of the volatility of private consumption, and 20 percent of the volatility of real GDP.

of such literature. In this final section, we provide three possible directions for future research.

The first avenue for future research is to explore the mutual interactions between business cycles and economic growth and their macroeconomic impacts. There are a number of studies focusing on one of two directions in this area; from cycles to growth, or vice versa. However, as we have discussed in this paper, business cycles and economic growth are likely to reinforce each other. Concerning hysteresis, shocks causing recessions might help economic growth rather than causing its slowdown. More studies are needed to understand the macroeconomic implications of the interaction between cycles and growth. International comparisons on this issue will be also important.

The second avenue for future research is to investigate the roles of monetary and fiscal policies in the presence of the interaction. Reifschneider, Wascher, and Wilcox (2013) point out that monetary easing can also help economic recovery via the supply side if weak demand places downward pressure on aggregate supply. Galí (2016) examines monetary policy rules in the presence of hysteresis in labor markets. He shows that policies stabilizing unemployment and wage inflation as well as inflation will achieve better social welfare outcomes than those which only minimize inflation volatility. Moreover, stronger hysteresis leads to a larger welfare gains from policies addressing labor market conditions. DeLong and Summers (2012) emphasize that expansionary fiscal policy can shift potential output upward in the presence of hysteresis.[41] Yellen (2016) discusses relevance of running a "high-pressure economy" to raise potential growth in the presence of hysteresis. High-pressure economy means a state in which policymakers keep stimulating aggregate demand over a long period. She argues that, while potential growth can rise under the high-pressure economy, monetary easing continuing on for too long may increase the risk of destabilizing financial markets and worsening price stability.[42] It is important to explore roles of economic policies taking account of the interaction between business cycles and economic growth.

The third avenue for future research is to study the desired relationships between policy stimulus and structural reform. This paper has reviewed mechanisms which generate a trade-off between short-run and long-run economic dynamics. In this sense, it is necessary to discuss whether policymakers should conduct structural reform to raise long-term economic growth at the cost of a short-run economic shortfall. It is also debatable whether policymakers should conduct policy stimulus in order to mitigate economic loss due to structural reform.

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41. In general, to maintain the balance of future government debt under an expansionary fiscal policy, the government needs a sufficiently high economic growth rate and high fiscal multiplier. The literature suggests that sufficiently strong hysteresis can be a complement to these conditions. In the presence of hysteresis, a shock to increase aggregate demand can shift up the trend of economic growth.
42. Yellen (2016) borrows the term high-pressure economy from Okun, Fellner, and Greenspan (1973). They classify an economy with low (high) unemployment rate as a high-pressure (low-pressure) economy, and discuss possible consequences of high and low-pressure economies. In a low-pressure economy, workers prefer not to change jobs due to the high risk of losing their jobs under a high unemployment rate. Consequently, the majority of workers do not move from low to high productivity sectors. In contrast, in a high-pressure economy more workers are willing to move to a high productivity sector. This results in the improvement of aggregate productivity which Okun calls the "productivity bonus." Technically, he sets the criterion of low and high unemployment rates as 4 percent and 5 percent respectively, referring to the target unemployment rate in the early 1970s.

Though in this study we have surveyed only a few, there is a broad range of discussions on the interaction between business cycles and economic growth.[43] We hope that this study will encourage further discussion on this issue amongst academic researchers and practitioners.

43. An example of a mechanism which can cause hysteresis effects that this study does not cover is a mechanism of expectation formation or decision making where agents learn from their own past experiences. Malmendier and Nagel (2011, 2016) show that households' past experience of stock prices significantly affects their subsequent risk-taking behavior in financial markets. They obtain similar results on past inflation and inflation expectations. A few recent studies on Japan's economy support the relevance of the mechanism. See Diamond, Watanabe, and Watanabe (2017) for expectations of households, and Koga and Kato (2017) for those of firms.

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