

Does Product Market Competition Promote Economic Growth? —Two Bargaining Systems and Creative Destruction—^{*†}

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Abstract

Is more intense product market competition good or bad for economic growth? This paper constructs an endogenous growth model with bargaining, and derives an inverted-U-shaped relationship between competition and growth. We compare two bargaining systems of efficient bargaining (EB) and right-to-manage (RTM) in the model of creative destruction. An increase in the bargaining power of labor which decreases the number of researchers always decays growth. If the unemployment rate is high, or if the degree of competition is low, policies for promoting competition are good for growth. Greater competition reduces monopoly rents that induce firms to innovate while it decreases the natural rate of unemployment and increases total employment. Since the degree of competition for maximizing the rate of economic growth in the RTM is larger than in the EB, the optimal competitive strategy for growth depends on which of bargaining systems an economy adopts. When unemployment benefits are low, the positive effect of competition on growth emerges easily because Okun's law works effectively. We propose strategies for growth.

Keywords: product market competition; strategy for growth; Okun's law; efficient bargaining (EB); right-to-manage (RTM); employment-creating effect; incentive effect; unemployment benefit

JEL classifications: O31, E24, L16.

1 Introduction

Whether more intense product market competition raises the rate of economic growth is a crucial question. Theoretically, in the innovation-based endogenous growth models¹ with R&D sector, more intense competition, which reduces markups and monopoly rents that induce firms to innovate, always reduces long-run growth. However, this theoretical result appears to be counterintuitive because monopoly is thought to be the key source of inefficiency. Many economists have believed

that competition exerts downward pressure on costs, provides incentives for efficient organization, reduces slack, and drives innovation. Empirical works such as Nickell (1996) [33] and Blundell et al. (1999) [11] show a positive correlation between competition and productivity growth within a firm or industry, measuring competition either by the number of competitors in the same industry or by the inverse of a market share of profitability index². Porter (1990) insists that competition forces firms to innovate to survive, and competition is good for growth. Adam Smith commented that “monopoly ... is a great enemy to good management” and insisted on gradual deregulation. Peretto-(2015)-[38] analyzes transformation from a state of affairs with no profit-driven innovation (Smithian phase) to one with it (Schumpeterian phase). The effect of competition on the growth rate varies with phase.

The purpose of this paper is to derive an inversed-U-shaped relationship between competition and growth, and to propose strategies for growth. In a modern economy within Schumpeterian phase, how does the positive effect of competition on the growth rate appear? There are few theoretical papers to explain the positive effect of competition on growth. There are four approaches at present. First, the R&D with a step-by step. Second, decomposing into research and development. Third, agency considerations. Fourth, labor market imperfections, which is the one we emphasize in this paper. First, Schumpeterian endogenous growth model of Aghion and Howitt (1992) puts the leapfrogging assumption that the innovator is overtaken by outside researchers, and the model shows a negative effect of competition on innovation. In contrast, the assumption is replaced with a less radical step-by step assumption³ in the models of Aghion, Harris, and Vickers (1997) [4], Aghion et al. (2001) [6], and Aghion et al. (2002) [7]. According to them, there is an inversed-U-shaped relationship between growth and competition. How innovation or productivity growth (the flow of new patent) varies with the degree of competition (measured inversely by the ratio of firm rents to value added or to the asset value of the firm)? They show that when competition is initially low, an increase in competition should result in a faster average innovation rate since the “escape-competition” effects dominates. In contrast, when competition is high, an increase in competition should result in a slower average innovation rate since the “Schumpeterian effects” dominates. Second, Aghion and Howitt (1996) [3] decompose R&D activities into research and development. More competition between new and old product lines induces developers to switch from old to new lines rapidly, inducing a higher level of research and growth. Third, Aghion, Dewatripont, and Rey (1999) [5] analyze incentive effects of competition on technological adoption by non-profit maximizing managers. They shows that with conservative firms whose sole desire is to delay adoption of new technologies, competition tends to increase growth while subsidizing innovation tends to deteriorate it.

Fourth, we try to explain the inversed-U-shaped relationship between growth and competition by focusing on labor market imperfections. Solow (2000) [43] (p 185) insists on an integration of Okun’s law [Okun (1962) [36]] and growth models. Empirically, Daveri and Tabellini

(2000) [15] report a significant negative relationship between growth and unemployment⁴. Let us still put the leapfrogging assumption adopted by Aghion and Howitt (1992). We consider two bargaining systems. The first is an *efficient bargaining* (EB) which determines the wage rate as well as employment, proposed by McDonald and Solow (1981) [30]. The second is the bargaining system of the *right-to-manage* (RTM) which determines only the wage rate by negotiations, and the firm decides employment on the demand schedule for labor. We compare two bargaining systems in the endogenous growth model. There are two opposite effects of promoting competition. The positive effect of competition on employment is what we call the “*employment-creating effect*”. On the other hand, the negative effect of competition on the monopolistic profit and the incentive to the R&D is what we call the “*incentive effect*”⁵. When labor has some bargaining power, policies for promoting competition increase total employment. This is because more intense competition increases unemployment benefits and decreases the rate of unemployment. If the *employment-creating effect* dominates the *incentive effect*, competition fosters growth.

We show that when the unemployment rate is high to begin with, more intense competition, which decreases the unemployment rate, increases the rate of economic growth. This is because the *employment-creating effect* dominates. On the other hand, when the unemployment rate is low, a decrease in the degree of competition, which increases the unemployment rate, increases the rate of economic growth. This is because the *incentive effect* dominates. Therefore, there exists the desired degree of competition for attaining a maximum rate of economic growth. In an economy where markups in the goods markets are too high, it is desired to reduce markups and natural rate of unemployment for growth. Although the higher markup gives the incentive to R&D, it generates inefficiency, that is to say, a dead weight loss due to monopoly and unemployment. Therefore, there is a trade-off as for promoting competition between the *employment-creating effect* and the *incentive effect*.

According to Blanchard and Giavazzi (2003) [10], the unemployment benefit which expresses the reservation wage depends negatively on the rate of unemployment. More intense competition increases the unemployment benefit, which decreases the unemployment rate. Since promoting competition increases total employment, it brings about economic growth through Okun’s law. Bargaining power of labor does not affect the unemployment benefit and the natural rate of unemployment under the efficient bargaining (EB). On the other hand, under the right-to-manage (RTM), the increase in bargaining power of labor decreases the unemployment benefit and increases the natural rate of unemployment. A decrease in the bargaining power of labor enhances economic growth under two systems.

Empirically, Carmeci and Mauro (2003) [14] and Brauninger and Pannenberg (2002) [13] emphasize the negative effect of unionization of labor on growth⁶. Through wage bargaining, the union can capture some of monopoly profits. Since the firm anticipates hold-up, it has less incentive

to invest in R&D. Theoretically, Palokangas (1996) [37], Lingens (2003) [28], and Lingens (2007) [29] focus on the effect of labor market imperfection on growth. They distinguish low-skilled and high-skilled labor and the union bargains over the low-skilled labor wage. However, they do not focus on the effect of competition on growth. Moreover, in their models, only the wage rate is determined by bargaining, while employments are determined by profit maximization. That is, their bargaining system is only the right-to-manage (RTM). In contrast, we compare the EB and the RTM.

Too much generous unemployment benefit is one of problems in continental European economy. When unemployment benefits are low, it is easy for Okun's law to hold. Then, we obtain the positive effect of competition on growth. The lower the unemployment benefits is, the *employment-creating effects* function powerfully.

We propose policy prescriptions. Strategies for growth take three steps. First, the decrease in the bargaining power of labor is good for growth. Furthermore, the lower unemployment benefits are good for growth. Second, we emphasize that the optimal strategy for growth depends on which of bargaining systems an economy adopts because the degree of competition for maximizing the rate of growth in the RTM is larger than in the EB. Given the degree of competition, the switch to more desired bargaining system from EB (RTM) to RTM (EB) is good for growth⁷. Finally, with goal of maximal rate of growth, adjusting the degree of competition is good for growth. If the natural rate of unemployment is high, the policy promoting competition is good for growth. This paper may be a clue to solve the problem of productivity slowdown and high rate of unemployment suffered in continental Europe.

Shortening patent length implies a kind of policies promoting competition. Finite patent length in the growth model is analyzed by Judd (1985) [25], Iwaisako and Futagami (2003) [21], and Futagami and Iwaisako (2007) [17]. In their models, extending the patent length (that is, strengthening monopoly power) enhances economic growth by raising the rate of return of R&D. In other word, infinite patent length⁸ is good for growth. Therefore, there is still a negative effect of competition on growth in their models.

The remaining paper is organized as follows. Section 2 presents the quality-ladder endogenous growth model with efficient bargaining (EB). Section 3 presents the model with the right-to-manage (RTM). Section 4 compares the two bargaining systems. Section 5 proposes strategies for growth. Section 6 concludes this paper.

2 The Model with Efficient Bargaining

2.1 Households

We assume that consumers are risk-neutral, and they consume all earnings in each instance. The number of population is denoted by a constant $N > 0$. The interest rate corresponds to the rate of subjective time preference $\rho > 0$.

2.2 Final Goods Sector

Final goods are produced according to $Y_n = A_n x_n^\alpha$, where A_n is the quality of intermediate goods, n is the number of innovations, x_n is an input of intermediate goods, and $\alpha \in (0, 1)$ is a parameter. The production function is constant return to scale in x_n and another kind of input whose quality is normalized to one. An innovation raises the quality by a factor $\gamma > 1$, so that innovation process is given by $A_{n+1} = \gamma A_n$. The profit-maximization condition of final goods producers is $A_n \alpha x_n^{\alpha-1} = p_n$, where left-hand side is the marginal product of x_n while the right-hand side is the price of intermediate goods p_n .

2.3 Intermediate Goods Sector

There is a monopoly firm producing x_n . When quality innovation occurs with creation of a new product of quality A_{n+1} , the intermediate goods x_n become obsolete and eventually goes out of the market. Then, turn to the product x_{n+1} available in the market. The patent of the product is protected over infinite horizon. The monopolist sells intermediate goods to final goods sectors, facing a demand curve for the products, that is $A_n \alpha x_n^{\alpha-1} = p_n$. We assume that production of one unit of x_n requires one unit of flow labor services. The profit of the monopolist is given by $\pi_n = p_n x_n - w_n x_n = A_n \alpha x_n^\alpha - w_n x_n$.

2.4 The R&D Sector

The R&D sector is competitive. When the quality level of intermediate goods is A_n , the next-generation goods will be invented according to a Poisson distribution with an arrival rate of δR_n , where $\delta > 0$ is R&D productivity or an arrival rate of innovation when one worker is used in research⁹. Here, R_n is the number of research workers when it is the number of workers used in R&D which aims to generate the $(n+1)$ th innovation. Note that the probability of no innovation is equal to $(1 - \delta R_n)$. Denote the sum of the expected present value of future flow of π_{n+1} by V_{n+1} . The value of innovation is according to

$$\rho V_{n+1} = \pi_{n+1} + (\delta R_{n+1} - V_{n+1}) + (1 - \delta R_{n+1}) \times 0. \quad (1)$$

where x_{n+1} becomes obsolete if x_{n+1} is invented with a Poisson arrival rate of δR_{n+1} . Here, $\delta R_{n+1}(-V_{n+1}) + (1 - \delta R_{n+1}) \times 0$ expresses the expected capital gain. The return from being a successful R&D innovator must be equal to the sum of a profit and capital loss due to an extra innovation. Since the product becomes obsolete due to an extra innovation, δR_{n+1} lowers the value of innovation. As R_{n+1} gets higher, V_{n+1} falls, which discourages the current R&D and reduces R_n . The innovating firm acquires a monopoly on the production of x that is useful until the next innovation. The n th innovation brings a negative externality (it kills the rents of the firm that produced the $n-1$ st innovation) and a positive externality (it makes possible the $t+1$ st innovation). The labor can work in manufacturing and earn wages w_n while the labor can engage in R&D and earn V_{n+1} with an arrival rate of δ . If there is free entry and risk neutrality in R&D, entry will occur until the cost of conducting R&D is equal to the expected value of the innovation: $w_n R_{n+1} = \delta R_{n+1} V_{n+1} + (1 - \delta R_{n+1}) \times 0$. In equilibrium, we obtain

$$w_n = \delta V_{n+1}. \quad (2)$$

2.5 Efficient Bargaining

Let us consider two bargaining systems. First is an efficient bargaining (EB) which determines the wage rate as well as employment. The EB is analyzed in this section. Second is a bargaining of the right-to-manage (RTM) which determines only the wage rate by negotiations, and the firm decides employment unilaterally on the demand schedule for labor. Let us consider the RTM case in the next section.

According to Blanchard and Giavazzi (2003) [10], denote the unemployment benefit (that is the wage equivalent of being unemployed) by $f(u) > 0$, and it is a decreasing function of the unemployment rate $u \in [0, 1]$. That is, we assume $f'(u) < 0$. Higher unemployment makes it more painful to be unemployed. We assume that $f(0)$ is sufficiently high and $f(1)$ is sufficiently low so that the unemployment rate is strictly between 0 and 1. There does not exist the government, and the unemployment benefits are provided by the employed¹⁰.

Labor can get the labor rent which is expressed by the surplus to workers from working in the monopoly firm $[w_n - Pf(u)]x_n$, where $f(u)$ can be interpreted as the reservation wage or unemployment benefit, and P is the price of unemployment benefit. Note that the benefit f has some unit. One benefit f corresponds to P intermediate goods. Therefore $Pf(u)$ expresses the nominal unemployment benefit. On the other hand, a monopoly firm gets the profit $\pi_n = A_n \alpha x_n^\alpha - w_n x_n$.

The efficient bargaining (EB) chooses not only the wage rate w_n but also employment x_n to maximize the Nash bargaining product given by

$$\max_{\{w_n, x_n\}} \beta \log [[w_n - Pf(u)]x_n] + (1 - \beta) \log [A_n \alpha x_n^\alpha - w_n x_n], \quad (3)$$

where β exhibits the bargaining power of labors¹¹.

By differentiating the Nash bargaining with respect to the employment x_n , we obtain

$$\frac{\beta}{x_n} + \frac{(1-\beta)[\alpha A_n \alpha x_n^{\alpha-1} - w_n]}{\pi_n} = 0. \quad (4)$$

By differentiating the Nash bargaining with respect to the wage rate w_n , we obtain

$$\frac{\beta}{x_n} = \frac{(1-\beta)[w - Pf(u)]}{\pi_n}. \quad (5)$$

By substituting (5) into (4), we obtain the monopoly price in terms of unemployment benefit

$$\frac{p_n}{P} = \frac{f(u)}{\alpha}, \quad (6)$$

where $\frac{1}{\alpha}$ represents the markup and the degree of monopoly in the intermediate goods market. Here, $\alpha=1$ corresponds to the perfect competition while $\alpha=0$ does to the monopoly in the goods market. Note that in the case of efficient bargaining (EB), the markup puts over the unemployment benefit. The optimal wage equation (5) can be written as

$$\frac{w_n}{P} = \beta \left(\frac{p_n}{P} \right) + (1-\beta)f(u) = f(u) \left[\frac{\beta}{\alpha} + (1-\beta) \right], \quad (7)$$

where we use the monopoly price (6). The real wage is set as a weighted average of the reservation wage and the relative price. An increase in β increases the proportion of rents going to workers, and leads to a higher real wage. The monopoly price can be expressed as

$$p_n = \frac{w_n}{\beta + \alpha(1-\beta)} < \frac{w_n}{\alpha}. \quad (8)$$

In a basic model of Aghion and Howitt (1992), the monopoly price exhibits the markup $\left(\frac{1}{\alpha}\right)$ over wage rate. On the other hand, in our model with bargaining, the monopoly price is determined by the multiplier $\left(\frac{1}{\beta + \alpha(1-\beta)}\right)$ over wage rate. Let us call the multiplier $\left(\frac{1}{\beta + \alpha(1-\beta)}\right)$ “*effective markup*”. If bargaining power of labor (β) was null, then the *effective markup* would correspond to the standard markup which measures the degree of monopoly in the goods market.

From (8), we have $A_n \alpha x_n^{\alpha-1} = \frac{w_n}{\beta + \alpha(1-\beta)}$. If x_n is constant, $\frac{w_n}{A_n} = \frac{w_{n+1}}{A_{n+1}}$ holds. We obtain

$$\gamma = \frac{w_{n+1}}{w_n}. \quad (9)$$

The wage rate rises discretely by a factor $\gamma > 1$.

The monopoly profit under the efficient bargaining (EB) can be computed by

$$\pi_n = (p_n - w_n) x_n = \left[\frac{1}{\beta + \alpha(1-\beta)} - 1 \right] w_n x_n = \left[\frac{(1-\beta)(1-\alpha)}{\beta + \alpha(1-\beta)} \right] w_n x_n. \quad (10)$$

More intense product market competition decreases the monopoly rents: $\frac{\partial \pi_n}{\partial \alpha} < 0$.

The unionization captures some of monopoly profits because of

$$\frac{\partial \pi_n}{\partial \beta} = \frac{-(1-\alpha)}{[\beta + \alpha(1-\beta)]^2} w_n x_n < 0. \quad (11)$$

2.6 Steady-State Equilibrium in the Efficient Bargaining

From the equation (1), the non-arbitrage condition for the value of innovation is expressed by

$$(\rho + \delta R_{n+1}) = \frac{\pi_{n+1}}{V_{n+1}}, \quad (12)$$

where the right-hand side exhibits income gain. By substituting the profit (10), the wage equalization condition (2), and the wage process (9) into the income gain (12), we can obtain

$$(\rho + \delta R_{n+1}) = \gamma \delta \left[\frac{(1-\beta)(1-\alpha)}{\beta + \alpha(1-\beta)} \right] x_{n+1}. \text{ Let us consider the steady-state equilibrium. Dropping the}$$

subscript n , we have $(\rho + \delta R) = \gamma \delta \left[\frac{(1-\beta)(1-\alpha)}{\beta + \alpha(1-\beta)} \right] x$. The equilibrium of labor market is given by

$R + x = (1-u)N$, where the numbers of population (labor force), of unemployed, and of employment are denoted by N , uN , and $(1-u)N$, respectively. Here, R is the number of researchers in R&D sector while x is the number of manufacturing labor. From the equation (8), not only the wage rate but also the intermediate goods price rise discretely by a factor $\gamma > 1$. From the equation (6), the relative price $\frac{p_n}{P} = 1$ holds at the equilibrium. At the steady state, the natural rate of unemployment is determined

according to

$$\alpha = f(u), \quad 0 < \alpha < 1, \quad (13)$$

where an increase in competition (α) increases the unemployment benefit, reduces the unemployment rate. The wage rate in terms of benefit under the EB is given by $\frac{w_n^{EB}}{P} = \beta + \alpha(1-\beta)$.

We can compute the steady state equilibrium by

$$x = \frac{\rho + \delta R}{\gamma \delta} \left[\frac{\beta + \alpha(1-\beta)}{(1-\beta)(1-\alpha)} \right], \quad (14)$$

$$x = (1-u)N - R, \quad (15)$$

and (13). By eliminating x from (14) and (15), and by solving for R , we obtain the number of researchers at the steady state in the EB as follows:

$$R = \frac{(1-u)N - \frac{\rho}{\gamma\delta} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]}{1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]}. \quad (16)$$

The non-arbitrage condition (14) is an upward-sloping curve while the labor market equilibrium (15) is a downward-sloping curve, in the Figure 1. The condition of a positive numerator in (22) given by $(1-u)N > \left(\frac{\rho}{\gamma\delta}\right) \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)}\right]$ ensures the existence of a steady-state equilibrium.

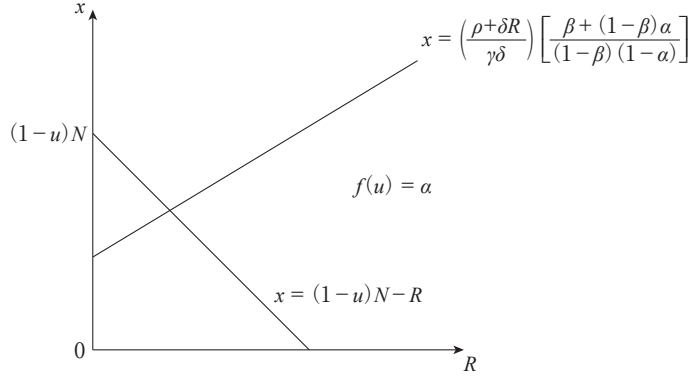


Figure 1: Equilibrium under the Efficient bargaining (EB)

2.7 Expected Rate of Economic Growth

Steady state final output in terms of real time is given by $Y_t = \gamma^n x^a$. The expected growth rate is computed by $g \equiv \frac{\partial E(\log Y_t)}{\partial t} = \frac{\partial E[n_t]}{\partial t} \log \gamma$, where $\frac{\partial E[n_t]}{\partial t}$ is the expected number of innovations during a unit time interval. Since innovations follows a Poisson distribution with an arrival rate of δR , the time length between two successive innovations is exponentially distributed and the average time length between one innovation and another is $\frac{1}{\delta R}$, which is the expected time length of one innovation. Therefore, δR is the expected number of innovations for a unit time interval. Thus, since we have $\frac{\partial E[n_t]}{\partial t} = \delta R$, the expected growth rate is given by $g \equiv \delta R \log \gamma$. If an economic policy increases the number of researchers R , then it is growth-enhancing policy. The expected rate of economic growth is computed by

$$g = \delta \left[\frac{(1-u)N - \frac{\rho}{\gamma\delta} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]}{1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]} \right] \log \gamma, \quad (17)$$

where note that the unemployment rate is given by $u=f^{-1}(\alpha)$.

2.8 Effect of Bargaining Power of Labor on Economic Growth in the EB

In the EB, the bargaining power of labor (β) does not affect the equation (15). On the other hand, an increase in the bargaining power of labor shifts up the upward-sloping curve (14), and it increases the labor in manufacturing, because of $\frac{\partial x}{\partial \beta} = \frac{1}{(1-\beta)^2(1-\alpha)} > 0$. Therefore, we have

Proposition 1. See Figure 2.

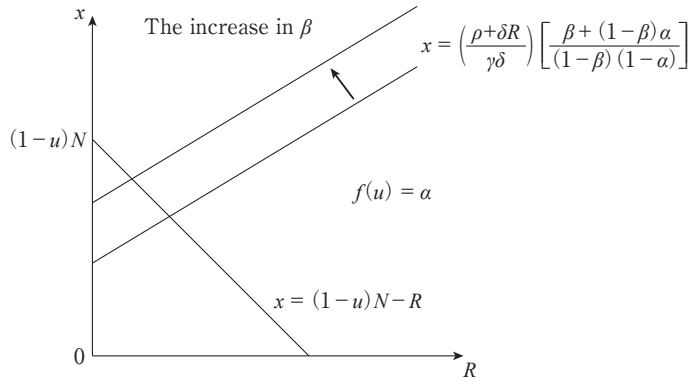


Figure 2: The increase in the bargaining power of labor in the efficient bargaining (EB)

Proposition 1

An increase in the bargaining power of labor decreases the number of researchers but increases the number of manufacturing labor; which decreases the rate of economic growth under the efficient bargaining.

Since an increase in β does not affect the reservation wage, it leaves total employment unchanged. On the other hand, the increase in β increases the real wage and decreases the monopoly profits. The decline of an incentive to innovation forces labor out of the R&D sector. Therefore, it increases labor in manufacturing since the unemployment rate is unchanged.

Empirically, Carmeci and Mauro (2003) [14] and Brauningner and Pannenberg (2002) [13] show the negative effect of unionization of labor on economic growth. Through wage bargaining, the union can capture some of the quasi rents, which are generated by R&D investment of the firm. Since the firm anticipates hold-up, it has less incentive to invest in R & D, compared to a situation without unionization.

2.9 Effect of Competition on the Rate of Economic Growth in the EB

The competition¹² decreases the rate of unemployment as follows: $\frac{du}{d\alpha} = \frac{1}{f'(u)} < 0$. More intense competition increases the real wage (7) and decreases the unemployment rate since reservation wage increases. There are two opposite effects of promoting competition. On the one hand, the effect that an increase in competition increases employment is what we call the “*employment-creating effect*”. On the other hand, the effect that more intense competition decreases monopoly rents and makes the firm have less incentives to R&D investment is what we call the “*incentive effect*”. The effect of competition on the innovation is given by

$$\frac{\partial R}{\partial \alpha} = \frac{1}{\left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]\right)^2} \left[\frac{-1}{f'(u)} N \left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]\right) - \frac{\left[\frac{\rho}{\delta} + (1-u)N \right]}{(1-\beta)(1-\alpha)^2 \gamma} \right]. \quad (18)$$

The second-order sufficient condition is satisfied because of $\frac{\partial^2 R}{\partial \alpha^2} < 0$. If the inequality holds

$$\frac{-1}{f'(u)} N \left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]\right) > \frac{\left[\frac{\rho}{\delta} + (1-u)N \right]}{(1-\beta)(1-\alpha)^2 \gamma}, \quad (19)$$

then the effect of the degree of competition on the rate of economic growth is positive: $\frac{\partial R}{\partial \alpha} > 0$.

Figure 3 displays the case that the “*employment-creating effect*” dominates the *incentive effect*.

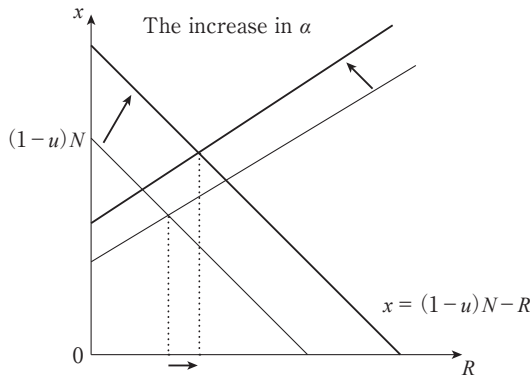


Figure 3: This figure displays the case of positive effect of the increase in the product market competition on the number of researcher. The “*employment effect*” dominates “*incentive effect*”.

When the derivative of the unemployment benefit function $f'(u) < 0$ is close to zero, and the unemployment rate is low to begin with, an increase in competition accelerates economic growth. In other words, when the rate of unemployment is high chronically, it is the policy such as antitrust policy and deregulation to decrease the rate of unemployment that enhances the rate of economic growth. This result occurs through Okun's law.

In contrast, if the inequality holds

$$\frac{-1}{f'(u)} N \left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right] \right) < \frac{\left[\frac{\rho}{\delta} + (1-u)N \right]}{(1-\beta)(1-\alpha)^2 \gamma}, \quad (20)$$

the effect of competition on economic growth is negative: $\frac{\partial R}{\partial \alpha} < 0$. When the derivative $f'(u) < 0$ is close to $-\infty$, and the unemployment rate is low to begin with, then intensifying competition slows down economic growth. This is because the policies for promoting competition reduces the monopoly profit and the incentive to innovations. That is, the *incentive effect* dominates. Thus, we can derive an inverted-U-shaped relationship between growth and competition.

2.10 Specifying the Unemployment Benefit Function in the EB

Suppose the unemployment benefit function as given by

$$f(u) = \eta(1-u), \quad (21)$$

where $\eta > \alpha > 0$. Then, since $\alpha = \eta(1-u)$ holds from (13), the natural rate of unemployment is determined by $u = 1 - \frac{\alpha}{\eta}$, where the constraint $0 < \alpha < \eta$ ensures the existence of the natural rate of unemployment between 0 and 1. The number of researchers is computed by

$$R = \frac{\frac{\alpha}{\eta} N - \frac{\rho}{\gamma \delta} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]}{1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]} \quad (22)$$

The expected rate of economic growth in the EB is computed by

$$g = \delta \left[\frac{\frac{\alpha}{\eta} N - \frac{\rho}{\gamma \delta} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]}{1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right]} \right] \log \gamma, \quad (23)$$

The effect of competition on innovation is given by

$$\frac{\partial R}{\partial \alpha} = \frac{1}{\left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right] \right)^2} \left[\frac{1}{\eta} N \left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right] \right) - \frac{\left[\frac{\rho}{\delta} + \frac{\alpha}{\eta} N \right]}{(1-\beta)(1-\alpha)^2 \gamma} \right]. \quad (24)$$

When the equation $\frac{1}{\eta} N \left(1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha}{(1-\beta)(1-\alpha)} \right] \right) = \frac{\left[\frac{\rho}{\delta} + \frac{\alpha}{\eta} N \right]}{(1-\beta)(1-\alpha)^2 \gamma}$ holds, competition

maximizes the rate of economic growth. Denote the desired degree of competition by α^* . By solving the equation $(1-\beta)(1-\gamma)\alpha^2 + 2[\beta+(1-\beta)\gamma]\alpha + \frac{\rho\eta}{\delta N} - [\beta+(1-\beta)\gamma] = 0$ for α , we obtain the desired competition as follows:

$$\alpha^* = \frac{-[\beta+(1-\beta)\gamma]}{(1-\beta)(1-\gamma)} + \sqrt{\frac{[\beta+(1-\beta)\gamma]^2}{(1-\beta)^2(1-\gamma)^2} - \frac{\left[\frac{\rho\eta}{\delta N} - [\beta+(1-\beta)\gamma] \right]}{(1-\beta)(1-\gamma)}}. \quad (25)$$

The condition given by $\rho\eta < \delta N [\beta + (1-\beta)\gamma]$ ensures the existence of the desired degree of competition $\alpha^* \in (0, 1)$. The desired natural rate of unemployment can be computed by $u^* = 1 - \frac{\alpha^*}{\eta}$. If the rate of unemployment is higher than u^* to begin with, in other words, if the degree of competition is less than α^* , then the desired policy prescription for growth is to promote competition. Its policy decreases the natural rate of unemployment, and increases total employment. Therefore, competition is good for growth because the “*employment-creating effect*” dominates. In order to obtain the positive effect of competition on growth, it is important for Okun’s law to work. Okun’s law is examined empirically by Lee (2000) [27], Prachowny (1993) [40], Moosa (1997) [32], and Attfield and Silverstone (1998) [9]. On the other hand, if the degree of competition is larger than α^* , competition is bad for growth since the *incentive effect* dominates.

The maximal expected growth rate in the EB is computed by

$$g^* \equiv \delta R^* \log \gamma = \delta \left[\frac{\frac{\alpha^*}{\eta} N - \frac{\rho}{\gamma\delta} \left[\frac{\beta + (1-\beta)\alpha^*}{(1-\beta)(1-\alpha^*)} \right]}{1 + \frac{1}{\gamma} \left[\frac{\beta + (1-\beta)\alpha^*}{(1-\beta)(1-\alpha^*)} \right]} \right] \log \gamma. \quad (26)$$

where α^* is given by (25).

Proposition 2

If the unemployment rate is higher than u^ , or if the degree of product market competition is lower than α^* to begin with, then the policy promoting competition is good for growth under the efficient bargaining.*

Our result is supported by works such as Nickell (1996), Blundell et al. (1995), and Nickell et al (1997) [34] showing a positive correlation between competition and growth.

3 The Model with Bargaining of The Right To Manage

Bargaining system of the right-to-manage (RTM) which determines only the wage rate by negotiations, and the firm decides employment unilaterally on the demand schedule for labor. Employment is chosen ex post by firms so as to maximize profit given the bargained wage. In the RTM, we cannot use the equation (4). Alternatively, optimal employment is determined by profit-maximization condition $\alpha A_n \alpha_n^{\alpha-1} = w_n$. Under the RTM, the monopoly price is well-known form given by $p_n = \frac{w_n}{\alpha}$. The relative price is a markup over the real wage, not the reservation wage. Compare the monopoly price $p_n = \frac{Pf(u)}{\alpha}$ in the EB and $p_n = \frac{w_n}{\alpha}$ in the RTM. By substituting the optimal bargaining-wage equation $\frac{w_n}{P} = \beta \left(\frac{p_n}{P} \right) + (1-\beta)f(u)$ into $\frac{p_n}{P} = \frac{1}{\alpha} \left(\frac{w_n}{P} \right)$, we can obtain the monopoly price under the RTM:

$$\frac{p_n}{P} = \frac{1}{\alpha} \left(\frac{w_n}{P} \right) = \left(\frac{1-\beta}{\alpha-\beta} \right) f(u). \quad (27)$$

The “effective markup” over reservation wage in the RTM is given by $\left(\frac{1-\beta}{\alpha-\beta} \right)$. Here, $\alpha - \beta > 0$ is needed to get a positive monopolistic price under the RTM.

Assumption under the RTM: $\alpha > \beta$ is required. In other words, the degree of monopoly in the goods market $\frac{1}{\alpha}$ should be less than the inverse of bargaining power of labor β^{-1} .

Under the RTM, the monopolistic profit is the same as in a basic model of Aghion and Howitt (1992). The profit is well-known given by $\pi_n = (p_n - w_n)x_n = \left(\frac{1}{\alpha} - 1 \right) w_n x_n = \left(\frac{1-\alpha}{\alpha} \right) w_n x_n$. The non-arbitrage condition (12) provides $\rho + \delta R = \gamma \delta \left(\frac{1-\alpha}{\alpha} \right) x_n$. The labor market equilibrium is given by $x = (1-u)N - R$.

3.1 Steady-State Equilibrium in the Right To Manage

At the equilibrium, the relative price $\frac{p_n}{P} = 1$ holds. Therefore, the natural rate of unemployment in the RTM must satisfy

$$\frac{\alpha-\beta}{1-\beta} = f(u), \quad \beta < \alpha < 1. \quad (28)$$

The real wage under the RTM $\frac{w_n^{RTM}}{P} = \alpha$ is lower than that $\frac{w_n^{EB}}{P} = \beta + \alpha(1-\beta)$ under the EB. The

steady-state equilibrium in the RTM can be computed by (28),

$$x = \frac{\alpha(\rho + \delta R)}{(1-\alpha)\gamma\delta}, \quad \text{and} \quad (29)$$

$$x = (1-u)N - R. \quad (30)$$

The number of researchers at the steady state in the RTM is given by [See Figure 4]

$$R = \frac{(1-u)N - \frac{\alpha\rho}{(1-\alpha)\gamma\delta}}{1 + \frac{\alpha}{(1-\alpha)\gamma}}, \quad (31)$$

where note that $u = f^{-1}\left(\frac{\alpha-\beta}{1-\beta}\right)$.

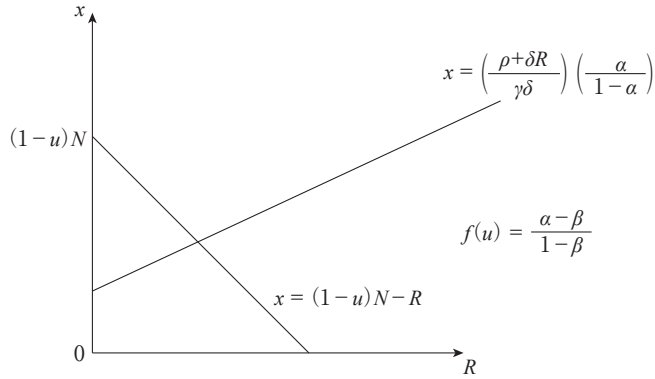


Figure 4: Equilibrium under the Right to manage (RTM)

The condition of a positive numerator in (31) given by $(1-u)N > \frac{\alpha\rho}{(1-\alpha)\gamma\delta}$ ensures the existence of a steady-state equilibrium.

3.2 Effect of Bargaining Power of Labor on Economic Growth in the RTM

Recall that the bargaining power of labor does not affect the rate of unemployment in the case of the EB. However, an increase in the bargaining power of labor increases the rate of unemployment in the RTM

$$\frac{\partial u}{\partial \beta} = \frac{-(1-\alpha)}{(1-\beta)^2 f'(u)} > 0. \quad (32)$$

An increase in β does not affect the real wage in the RTM which depends only on competition α . The bargaining power of labor does not affect the equation (29) in the RTM. On the other hand, by differentiating $x = (1 - u)N - R$ with respect to β , we obtain

$$\frac{\partial x}{\partial \beta} = -N \frac{\partial u}{\partial \beta} = \frac{N(1-\alpha)}{(1-\beta)^2 f'(u)} < 0. \quad (33)$$

Since the increase in the bargaining power of labor increases the rate of unemployment, it decreases employment in manufactured goods sector as well as R&D sector. See Figure 5.

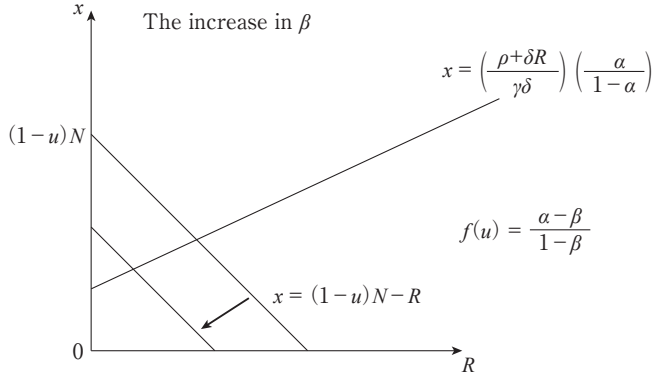


Figure 5: The increase in the bargaining power of labor in the right to manage (RTM)

Proposition 3

An increase in the bargaining power of labor decreases not only the number of researchers but also the number of manufacturing labor, which decreases the rate of economic growth under the right-to-manage.

The increase in the bargaining power of labor under the RTM decreases total employment eventually. An increase in β increases the real wage but it leaves the unemployment rate unchanged in the EB. On the other hand, the increase in β increases the unemployment rate but it leaves the real wage unchanged in the RTM. Therefore, the effect of bargaining power of labor on labor market under the RTM is different under the RB. Compare Figure 2 and Figure 5.

3.3 Effect of Competition on the Rate of Economic Growth in the RTM

The effect of competition on the rate of unemployment in the RTM is negative

$$\frac{\partial u}{\partial \alpha} = \frac{1}{(1-\beta)f'(u)} < 0. \quad (34)$$

One percent increase in competition α increases the real wage by one percent in the RTM. The effect of competition on the innovations is examined by

$$\frac{\partial R}{\partial \alpha} = \frac{1}{\left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)^2} \left[\frac{-N \left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)}{(1-\beta)f'(u)} - \frac{\left[\frac{\rho}{\delta} + (1-u)N\right]}{(1-\alpha)^2\gamma} \right]. \quad (35)$$

The second-order sufficient condition is satisfied because of $\frac{\partial^2 R}{\partial \alpha^2} < 0$. If the condition given by

$$\frac{-N \left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)}{(1-\beta)f'(u)} > \frac{\left[\frac{\rho}{\delta} + (1-u)N\right]}{(1-\alpha)^2\gamma} \quad (36)$$

holds, then the effect of competition on growth is positive in the RTM: $\frac{\partial R}{\partial \alpha} > 0$. The higher the bargaining power of labor is, the more an increase in competition increases the rate of economic growth. This is because the inequality (36) is easy to hold for higher β .

3.4 Specifying the Unemployment Benefit Function in the RTM

Under the specification of $f(u) = \eta(1-u)$, the equation (28) becomes $\frac{\alpha-\beta}{1-\beta} = \eta(1-u)$. The constraint $\frac{\alpha-\beta}{1-\beta} < \eta$ ensures the unemployment rate between $u \in (0, 1)$ in the RTM.

The natural rate of unemployment in the RTM is given by

$$u = \frac{\eta - \alpha + \beta(1-\eta)}{\eta(1-\beta)}. \quad (37)$$

The constraint $\frac{\alpha-\beta}{1-\beta} < \eta$ implies $\eta - \alpha + \beta(1-\eta) > 0$.

Under the specification, the number of researchers in the RTM at the steady state is

$$R = \frac{\left(\frac{\alpha-\beta}{\eta(1-\beta)}\right) N - \frac{\alpha\rho}{(1-\alpha)\gamma\delta}}{1 + \frac{\alpha}{(1-\alpha)\gamma}}. \quad (38)$$

The expected rate of economic growth in the RTM is computed by

$$g^{RTM} = \delta \left[\frac{\left(\frac{\alpha-\beta}{\eta(1-\beta)}\right) N - \frac{\alpha\rho}{(1-\alpha)\gamma\delta}}{1 + \frac{\alpha}{(1-\alpha)\gamma}} \right] \log \gamma. \quad (39)$$

Under the specification, the effect of competition on the innovations in the RTM is given by

$$\frac{\partial R}{\partial \alpha} = \frac{1}{\left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)^2} \left[\frac{N \left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)}{\eta(1-\beta)} - \frac{\left[\frac{\rho}{\delta} + \left(\frac{\alpha-\beta}{\eta(1-\beta)}\right)N\right]}{(1-\alpha)^2\gamma} \right]. \quad (40)$$

If the equation $\frac{N \left(1 + \frac{\alpha}{(1-\alpha)\gamma}\right)}{\eta(1-\beta)} = \frac{\left[\frac{\rho}{\delta} + \left(\frac{\alpha-\beta}{\eta(1-\beta)}\right)N\right]}{(1-\alpha)^2\gamma}$ holds, competition maximizes the

rate of economic growth. By solving the equation $N(1-\gamma)\alpha^2 + 2N\gamma\alpha + \frac{\rho}{\delta}(1-\beta)\eta - N(\gamma + \beta) = 0$ for α , we obtain the desired degree of competition in the RTM as follows:

$$\alpha^{**} = \frac{-\gamma}{1-\gamma} + \sqrt{\left(\frac{\gamma}{1-\gamma}\right)^2 - \frac{\left[\frac{\rho}{\delta}(1-\beta)\eta - N(\gamma + \beta)\right]}{N(1-\gamma)}}. \quad (41)$$

The inequality $\frac{\rho}{\delta}(1-\beta)\eta - N(\gamma + \beta) < -N(1-\gamma)\beta^2 - 2N\gamma\beta$ ensures the existence of the desired degree of competition $\alpha^{**} \in (\beta, 1)$. We can compute the desired natural rate of unemployment in the RTM, which maximizes the rate of economic growth, $u^{**} = \frac{\eta - \alpha^{**} + \beta(1-\eta)}{\eta(1-\beta)}$. The maximal expected growth rate in the RTM is computed by

$$g^{**} \equiv \delta R^{**} \log \gamma = \delta \left[\frac{\left(\frac{\alpha^{**} - \beta}{\eta(1-\beta)}\right)N - \frac{\alpha^{**}\rho}{(1-\alpha^{**})\gamma\delta}}{1 + \frac{\alpha^{**}}{(1-\alpha^{**})\gamma}} \right] \log \gamma. \quad (42)$$

Proposition 4

*If the unemployment rate is higher than u^{**} , or if the degree of competition is lower than α^{**} to begin with, then the policy promoting competition is good for economic growth under the right to manage.*

4 Comparing Two Bargaining Systems

More product market competition increases the real wage by the bargaining power of firms $1 - \beta$ in the EB. In contrast, more competition increases the real wage in proportion in the RTM. Therefore, employment-creating effect appears easily in the RTM.

We can derive the inversed-U-shaped relationship between growth and competition by considering imperfections in the labor market. By comparing the EB and the RTM, we have $\alpha^* <$

α^{**} . That is, the desired competition in the EB is less than in the RTM. The numerical example is provided under the parameters of $\eta=0.95$, $\rho=0.05$, $\gamma=1.20$, $\delta=1$, and $N=1$. This parameter settings are arbitrary, but we are interested in qualitative characteristics of the rate of economic growth. Figure 6 displays that in the case of the bargaining power of labor $\beta=0.3$, the rate of economic growth accomplishes about 3.2 percent at maximum. In the case of efficient bargaining (EB) [a curve with circle], the desired degree of competition is $\alpha^*=0.5$. In the case of the right to manage (RTM) [a solid curve], the desired degree of competition is $\alpha^{**}=0.65$. Figure 7 displays that in the case of the bargaining power of labor $\beta=0.5$, the rate of economic growth accomplishes about 2.09 percent at maximum. In the case of efficient bargaining (EB), the desired degree of competition is $\alpha^*=0.5$. In the case of the right to manage (RTM), the desired degree of competition is $\alpha^{**}=0.75$.

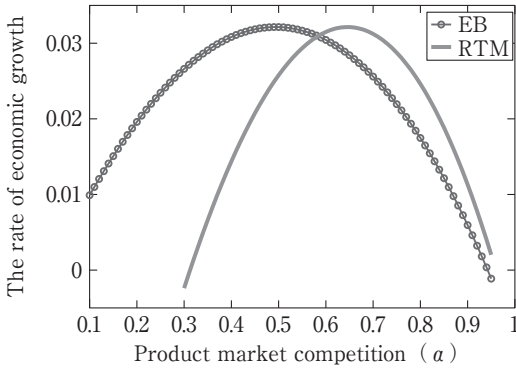


Figure 6: In the case of the bargaining power of labor $\beta = 0.3$, the effect of product market competition on the rate of economic growth. The numerical example is computed under the parameters: $\eta = 0.95$, $\rho = 0.05$, $\gamma = 1.20$, $\delta = 1$, and $N = 1$.

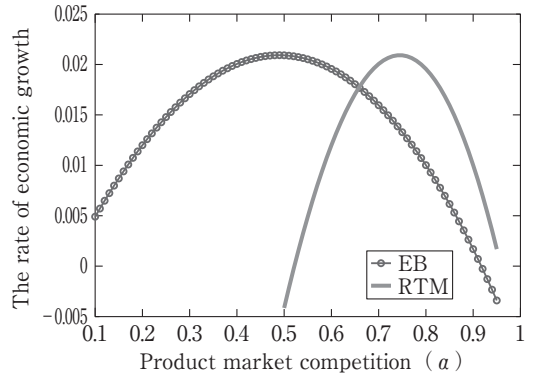


Figure 7: In the case of the bargaining power of labor $\beta = 0.5$, the effect of product market competition on the rate of economic growth. The numerical example is computed under the parameters: $\eta = 0.95$, $\rho = 0.05$, $\gamma = 1.20$, $\delta = 1$, and $N = 1$.

The degree of product market competition for maximizing the rate of economic growth in the RTM is larger than in the EB. That is, $\alpha^* < \alpha^{**}$ holds. If the degree of competition occupies an intermediate position between α^* and α^{**} , more intense competition decreases the rate of economic growth in the EB while it increases the rate of economic growth. For example, in the case of $\beta=0.5$, if the degree of competition is $\alpha=0.6$ to begin with in Figure 7, the policy promoting competition is bad for growth in the EB, but good for growth in the RTM. Therefore, we emphasize that the optimal competitive strategy for growth depends on which of bargaining systems does an economy adopts.

The “kurtosis” of a parabola with a sharp peak in the RTM is the more than in the EB. Therefore, if the desired degree of competition is less than α^{**} in the RTM to begin with, then the contribution of promoting competition to economic growth is large. But, if the desired degree of

competition is higher than α^{**} in the RTM, the “wrong” policy promoting competition reduces the rate of economic growth sharply. The natural rate of unemployment in the RTM is higher than in the EB because of $u^{EB} = 1 - \frac{\alpha}{\eta} < \frac{\eta - \alpha + \beta(1 - \eta)}{\eta(1 - \beta)} = u^{RTM}$. This is because the bargaining system with the RTM concerns with only the wage rate.

5 Strategies for economic growth

Continental European economies have a problem that unemployment benefits are too generous. When the parameter of unemployment benefits η is low, it is easy for Okun’s law to hold. Then, we obtain the positive effect of competition on growth while we have the negative correlation between unemployment rate and growth. The lower the unemployment benefit is, the *employment-creating effects* function powerfully. The lower level of unemployment benefits η enhances economic growth. See Figure 8 and 9 in the case of $\eta = 0.5$ and the EB.

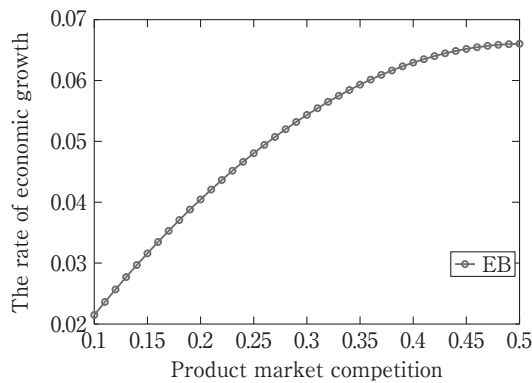


Figure 8: In the case of the level of unemployment benefits $\eta = 0.5$, we obtain the positive effect of competition on the rate of economic growth in the EB. The numerical example is computed under the parameters: $\beta = 0.3$, $\rho = 0.05$, $\gamma = 1.20$, $\delta = 1$, and $N = 1$.

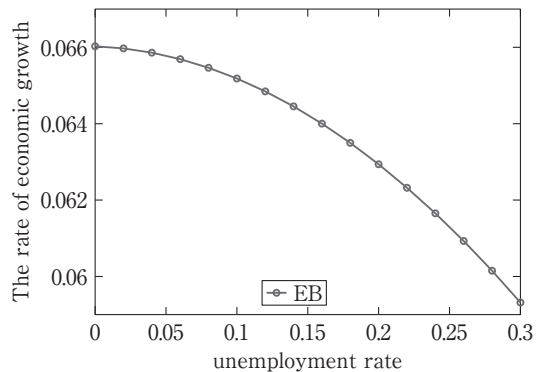


Figure 9: In the case of the level of unemployment benefits $\eta = 0.5$, we obtain Okun’s law in the EB. The numerical example is computed under the parameters: $\beta = 0.3$, $\rho = 0.05$, $\gamma = 1.20$, $\delta = 1$, and $N = 1$.

Proposition 5

When the level of unemployment benefits are low, the positive effect of competition on growth occurs easily because Okun’s law works effectively.

Remark

Look at Figure 6 in the case of $\beta = 0.3$. If the degree of product market competition is $\alpha = 0.4$, the growth-enhancing policy is to choose the efficient bargaining (EB) rather than the right-to-manage (RTM). On the other hand, if the degree of competition is $\alpha = 0.8$, the growth-enhancing policy is to adopt the RTM.

Strategies for economic growth take three steps. First, the decrease in the bargaining power of labor is good for growth. Furthermore, the lower unemployment benefits are good for growth. Second, it takes a long time to alter the degree of competition. Therefore, as above Remark describes, given the degree of competition, the switch to more desired bargaining system from EB (RTM) to RTM (EB) is good for growth. Finally, with goal of parabolic peak as in Figure 6, adjusting the degree of competition is good for growth. If the natural rate of unemployment is too high, the policy promoting competition such as antitrust, deregulation, and privatization is good for growth.

According to Jones (1995) [23] and Jones (1999) [24], the prediction that an increase in the size of the population raises the number of researchers, and leads to an increase in the growth rate of per capita income is at odds with 20th-century empirical evidence. However, Kremer (1993) [26] insists that the prediction may be valid in the long history. Is growth endogenous or semi-endogenous? Temple (2003) [44] mentions “it is difficult to see how we could ever conclude in favor of one type of model or the other.” We will have to retain a kind of agnosticism about the long-run properties of actual growth processes. In a semi-endogenous growth, the long-run growth rate is independent of policy. Since we are interested in policies and strategies for growth, this paper adopts an endogenous growth model rather than a semi-endogenous. In our model, scale effect still remains but it diminishes if the bargaining power of labor is high or if competition is too intense or too weak. A decrease in the unemployment rate, which increases the employment rate, will increase the number of researchers. Therefore, Okun’s law may deny eliminating the scale effects. Is Okun’s law consistent with elimination of scale effects pointed by Jones (1995)? Can Okun’s law marry a semi-endogenous growth model? This is a crucial problem in the growth theory.

6 Concluding Remarks

Product and labor market regulations are blamed for the poor European performance including the high rate of unemployment and the productivity slowdown. Remove these regulations, and Europe will be restored. However, does deregulation of goods market deteriorate innovation and technological progress? Is product market competition unambiguously detrimental to economic growth because it reduces the monopoly rents that reward successful innovators and discourages R&D investments? The result from R&D-based growth theories that exhibit the negative effect of

competition on growth has been shown to be partly counterfactual. Is more intense competition good for growth? Yes, when the unemployment rate is high. No, when it is low.

In continental European economy, unemployment benefits are too generous. Union wage bargaining is used for wage determination there. Therefore, it is significant to analyze interactions with imperfections in the labor and goods market. By considering imperfections in the labor market, we have shown that more intense competition may be growth-enhancing. This paper has analyzed an endogenous growth model with bargaining, and has derived an inversed-U-shaped relationship between competition and growth. We have compared two bargaining systems of efficient bargaining (EB) and the right to manage (RTM) in the endogenous growth model of creative destruction. An increase in the bargaining power of labor which decreases the number of researchers always decays growth, with an increase in manufacturing labor in the EB, but with a decrease in manufacturing labor in the RTM. Greater competition reduces monopoly rents that induce firms to innovate [*"incentive effect"*]. On the other hand, more intense competition decreases the natural rate of unemployment [*"employment-creating effect"*]. To begin with, if the unemployment rate is high, or if the degree of competition is low, then the policy promoting competition is good for growth. This result occurs when the *employment-creating effect* dominates the *incentive effect*. This paper has shown that the degree of competition for maximizing the rate of economic growth in the RTM is larger than in the EB. If the degree of competition in an actual economy occupies an intermediate position between the desired degree of competition in the EB and in the RTM, the policy promoting competition is bad for growth in the EB, but good for growth in the RTM. Therefore, we emphasize the optimal competitive strategy for growth depends on which of bargaining systems an economy adopts. We have proposed strategies for growth. First, decrease the bargaining power of labor and the level of unemployment benefits. Second, choose the desired bargaining system, given the degree of competition. Third, promote product market competition for an economy with the high rate of unemployment. Then, European economy will soar.

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- 1 They include Romer (1990) [42], Grossman and Helpman (1991) [19], Rivera-Batiz and Romer (1991) [41], and Aghion and Howitt (1992) [1].
- 2 Nickell et al (1997) [34] also show that average rents normalised on value-added (an inverse measure of competition) are negatively related to total factor productivity growth by using data from around 580 UK manufacturing companies.
- 3 See Aghion and Howitt (2009) [8] (p 7, and Ch 12). They consider the duopoly and two situations: (1) neck and neck sectors where both firms are at technological par with one another, and (2) unlevel sectors where the leader lies one step ahead of its competitor (the follower) in the same industry. Then, there is a positive effect of competition on innovation due to the “escape-competition” effects that more competition induces neck-and-neck firms to innovate to escape from a situation where competition constraints profits. On the other hand, the “Schumpeterian effect” leads to a negative effect of of competition on innovation.
- 4 Theoretically, Aghion and Howitt (1994) [2] analyzes the effect of growth on the long-run unemployment using a search model. In our paper, the reversed causality is analyzed. Aghion and Howitt (1994) do not focus on the effect of competition on growth. We focus on structural unemployment, but not frictional unemployment.
- 5 Since the bargaining power of labor is zero in the models of Grossman and Helpman (1991), Romer (1990), and Aghion and Howitt (1992), there exists only *incentive effect* in their models.
- 6 Nickell and Layard (1999) [35] insist that labor unions might foster growth. This is because the increase in the wage rate due to unionization increases the incentive for firms to invest in labor-saving technologies, which leads to the more R&D investment.
- 7 How the desired bargaining system should be chosen in a real world? By bargaining! Or, the government authority may choose it.
- 8 Since extending the patent length reduces the amount of output by increasing the proportion of monopolistic sector and the amount of consumption, Iwaisako and Futagami (2003) [21] show that there is the finite patent length maximizing the social welfare, unlike Judd (1985). There is the possibility of the negative effect of extending the patent length on growth. See Michel and Nyssen (1998) [31], Goh and Oliver (2002) [18], Furukawa (2007) [16], Horii and Iwaisako (2007) [20], and Iwaisako and Futagami (2013) [22]. Their papers are complement to our paper explaining the inversed-U-shaped relationship between growth and competition.
- 9 Broadly speaking, an increase in δ may come not only from progress of education and science but also from the elimination of state monopolies, or the reduction of red tape associated with the creation of new firms.
- 10 Their assumption is by spirit of reciprocity. For example, a Ghent system of labor union is operating in Denmark, Finland, Iceland, and Sweden. Under the Ghent system, workers have a bigger incentive to join a union. Under the Ghent system, nonmembers also may receive unemployment benefits but at a low replacement rate (ratio of benefits to wages) than for those who are union members. The unemployed who belongs to labor union can enjoy more benefits.
- 11 Here, β reflects any aspect of labor market regulation ranging from the existence and the nature of extension agreements, to closed-shop arrangements, to rules on the right to strike, according to Blanchard and Giavazzi (2003).
- 12 In the context of European integration, increase in a may reflect the elimination of tariff barriers, or standardization measures making it easier to sell domestic products in other European Union countries.

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