Discussion Papers In Economics And Business

A Note on Commodity Taxation and Economic Growth

Kunihiko Konishi

Discussion Paper 13-22

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

A Note on Commodity Taxation and Economic Growth

Kunihiko Konishi

Discussion Paper 13-22

September 2013

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

A Note on Commodity Taxation and Economic Growth*

Kunihiko Konishi†

Abstract

This note reexamines the growth effects of commodity taxation and a manufacturing subsidy. By incorporating endogenous labor supply into a variety expansion model following Grossman and Helpman (1991), we derive new results. First, if households consider leisure to be important, an increase in the commodity tax rate can decrease the growth rate in the short run. Second, a small elasticity of substitution and a small manufacturing subsidy halt economic growth. Third, when the elasticity of substitution is small and sustained growth is possible, a decrease in the subsidy raises the short-run growth rate and decreases the long-run growth rate.

Keywords: Commodity taxation, Subsidy, Labor supply, Endogenous growth

JEL classification: E62, O41.

---

*We would like to thank Koichi Futagami and Tadashi Morita for their helpful comments and suggestions. Of course, any remaining errors are my responsibility.

†Graduate School of Economics, Osaka University, 1-7 Machikaneyama, Toyonaka, Osaka 560-0043, JAPAN; E-mail: nge008kk@student.econ.osaka-u.ac.jp

1 Introduction

The effects of consumption taxation have been examined in the endogenous growth literature. King and Rebelo (1990), Rebelo (1991), Pecorino (1993), Devereux and Love (1994), Stokey and Rebelo (1995) and Milesi-Ferretti and Roubini (1998) show that taxes on consumption have negative or no effect on long-run growth. On the other hand, Jorgenson (1998) argues that implementing consumption taxes can boost the growth rate of the United States. Corresponding to this statement, Futagami and Doi (2004) considers the effect of specific consumption taxes (henceforth commodity taxes) in a variety expansion model following Grossman and Helpman (1991). They show that an increase in commodity taxes raises the long-run growth rate. In their model, an increase in the commodity tax rates reduces the demand for consumption goods and reallocates labor from production to R&D.

The objective of this note is to reexamine the growth effects of Futagami and Doi (2004) by incorporating endogenous labor supply. By considering labor-leisure choice, the growth effect of commodity taxation can change that of Futagami and Doi (2004); that is, an increase in the commodity tax rates reduces the growth rate. When the government raises the commodity tax, households reduce consumption of goods and increase leisure time. This can lead to a decrease in labor supply and the growth rate as well.

In addition to commodity taxation, we reexamine the effects of a manufacturing subsidy. In Grossman and Helpman (1991), they show that the manufacturing subsidy has no growth effect. On the other hand, Futagami and Doi (2004) shows that a decrease in the manufacturing subsidy raises the growth rate. In this note, we present some new results different from these existing literature.

The rest of this note is organized as follows. Section 2 establishes the model used in this note. Section 3 characterizes equilibrium dynamics and examines the existence of sustained growth. Section 4 examines the effects of fiscal policy. Section 5 states the conclusion.

2 Model

The factor market is perfectly competitive, while the goods market is monopolistically competitive, as explained below. The households have perfect foresight.

2.1 Households

The households maximize the following lifetime utility:

$$U \equiv \int_0^\infty e^{-\rho t}\left(D + \frac{l^{1-\sigma} - 1}{1-\sigma}\right)dt, \qquad (\sigma > 0), \tag{1}$$

where D stands for an instantaneous utility derived from the consumption of a composite good, $\rho > 0$ is the households' rate of time preference, and l is leisure time. D is given by

$$D = \left[\int_0^n x(j)^{\frac{\beta-1}{\beta}} dj \right]^{\frac{\beta}{\beta-1}}, \tag{2}$$

where $x(j)$ denotes the consumption of good j and n denotes the number of available varieties. We assume that $\beta > 1$. β is the elasticity of substitution between any two products. By denoting the expenditure of the households as E, we obtain the demand function for good j as follows:

$$x(j) = \frac{q(j)^{-\beta} E}{Q^{1-\beta}}, \tag{3}$$

where $q(j)$ is the consumer price, and Q is the price index defined as

$$Q = \left(\int_0^n q(i)^{1-\beta} di \right)^{\frac{1}{1-\beta}}. \tag{4}$$

Then, the households maximize U, subject to $\dot{A} = rA + W(\bar{L} - l) - E + T$, where A, r, W, $\bar{L}$, and T represent asset holdings, nominal rate of interest, wage rate, total time, and lump-sum transfers from the government. Here, capital letters represent nominal variables. By substituting (3) into (2), we obtain the indirect sub-utility function, $D = \frac{E}{Q}$. The following optimal conditions hold

$$\lambda = \frac{1}{Q}, \tag{5}$$

$$l^{-\sigma} = \lambda W, \tag{6}$$

$$r - \frac{\dot{Q}}{Q} = \rho, \tag{7}$$

where λ stands for the costate variable attached to the asset holdings. Since $\frac{\dot{Q}}{Q}$ is the inflation rate, we obtain $\tilde{r} = \rho$, where $\tilde{r}$ represents the real rate of interest.

2.2 Firms

This subsection considers producer behavior. Producers undertake two distinct activities. They create blueprints for new varieties of differentiated goods, and manufacture the differentiated goods that have been created by R&D.

We assume that each differentiated good is produced by a single firm because the good is infinitely protected by a patent. We further assume that one unit of labor input produces one unit of a differentiated good. The firm manufacturing good j (firm j) maximizes its own profit: $\pi(j) = P(j)x(j) - Wx(j)$, where $P(j)$ represents the producer price for firm j.

Next, we assume that the government imposes commodity tax on each good. τ represents the tax when it takes a positive value, or the subsidy when it takes a negative value. We assume that the commodity tax is constant over time and $\tau > -1$. The consumer price becomes

$$q(j) = P(j) + \tau, \quad j = 1, 2, \cdots, n. \tag{8}$$

Firm j charges the following price: $P(j) = \frac{\beta W + \tau}{\beta - 1} = P$. Therefore, all goods are priced equally. This pricing rule yields per brand operating profits as follows:

$$\pi = \frac{E}{\beta n}. \tag{9}$$

The wage rate W is normalized to be unity. Thus consumer price, producer price, and demand for goods become, respectively,

$$\begin{aligned} P &= \frac{\beta + \tau}{\beta - 1}, \\ q &= \frac{\beta}{\beta - 1}(1 + \tau), \\ x &= \frac{\beta - 1}{\beta} \frac{E}{(1 + \tau)n}. \end{aligned} \tag{10}$$

The no-arbitrage condition is given by

$$\pi + \dot{v} = rv, \tag{11}$$

where v denotes the value of a firm.

We consider the technology involved in developing a new good.[1] The R&D firms create blueprints and expand the varieties of goods available for consumption. We assume that one unit of R&D activity needs $\frac{a}{n}$ units of labor input. Because the knowledge that has already been produced includes all that is needed for invention, greater knowledge means faster further invention. Since the knowledge is non-rival and non-excludable, an expansion in the number of varieties reduces the labor input. We assume that firms enter freely into the R&D race. Therefore, the free entry condition is given by

$$v \begin{cases} = \frac{Wa}{n}, & \dot{n} > 0 \\ < \frac{Wa}{n}. & \dot{n} = 0. \end{cases} \tag{12}$$

2.3 Market equilibrium

The households supply $\bar{L} - l$ units of labor. Labor is used for R&D and production. The labor market equilibrium becomes

$$ag + \frac{E}{q} = \bar{L} - l, \tag{13}$$

where $g \equiv \frac{\dot{n}}{n}$. In addition, the government budget constraint is $T = \int_0^n \tau x(j) dj$.

[1] See Grossman and Helpman (1991) for more details of the R&D process.

3 Equilibrium dynamics

In this section, we characterize the equilibrium dynamics. From (4), (5), (6), and (10), we obtain

$$l = Q^{\frac{1}{\sigma}} = q^{\frac{1}{\sigma}} n^{\frac{1}{(1-\beta)\sigma}}. \tag{14}$$

Thus, (7) and (14) yields $r = \rho + \frac{1}{1-\beta} g$. By using (9) and (11), we obtain $\frac{\dot{v}}{v} = \rho + \frac{1}{1-\beta} g - \frac{1}{\beta} V$, where $V \equiv \frac{E}{vn}$. The free entry condition (12) implies that $v = \frac{a}{n}$ holds under $\dot{n} > 0$, and thus, $\frac{\dot{v}}{v} = -g$ and $E = aV$ hold. From these results, we obtain

$$\frac{1}{\beta} V = \rho + \frac{2-\beta}{1-\beta} g. \tag{15}$$

From (10), (13), (14), and (15), we obtain the following differential equation:

$$g = \frac{Z}{Y} - \frac{F}{Y} n^{-\frac{1}{(\beta-1)\sigma}}, \tag{16}$$

where $Y \equiv \beta + \tau - 1$, $Z \equiv \frac{1+\tau}{a} \bar{L} - (\beta - 1)\rho$, and $F \equiv \frac{1}{a}(1+\tau)^{\frac{\sigma+1}{\sigma}} \left(\frac{\beta}{\beta-1}\right)^{\frac{1}{\sigma}}$.

The actual labor time $\bar{L} - l$ must be positive. From (14) and $\dot{n} \geq 0$, leisure is the highest at time 0. Therefore, we have that $\bar{L} - l > 0$ if the initial number of varieties satisfies the following condition (see Appendix A.1):

$$n_0 > \hat{n} \equiv \left\{ \frac{a}{(1+\tau)\bar{L}} F \right\}^{(\beta-1)\sigma}. \tag{17}$$

Next, we consider the condition $E > 0$. From (15) and (16), we obtain

$$E = \frac{a\beta}{(\beta-1)Y} \left\{ -(1+\tau)J + (2-\beta) F n^{-\frac{1}{(\beta-1)\sigma}} \right\}, \tag{18}$$

where $J \equiv \frac{2-\beta}{a} \bar{L} - (\beta - 1)\rho$. As with (17), the initial number of varieties satisfies the following condition so that $E > 0$:

$$n_0 > \tilde{n} \equiv \left\{ \frac{(2-\beta)F}{(1+\tau)J} \right\}^{(\beta-1)\sigma}.$$

In addition, it is also necessary for $E > 0$ that J takes a different sign from Y (see Appendix A.2). As a result, we can sum up the condition that labor time and expenditure take positive values as follows:

$$n_0 > max\{\hat{n}, \tilde{n}\} \quad and \quad JY < 0.$$

To illustrate equation (16) in an (n, g) space, we have to take account of the signs of J, Y, and Z. Figure 1-1 illustrates the case wherein $J < 0$, $Y > 0$, and $Z > 0$. The number of varieties when $g = 0$ in equation (16), is given as follows:

$$n^* \equiv \left[\frac{F}{Z} \right]^{(\beta-1)\sigma}.$$

From Figure 1-1, $n_0 > n^*$ holds so that sustained growth is possible.[2] Similarly, Figure 1-2 illustrates the case wherein $J > 0$, $Y < 0$, and $Z < 0$. This implies that sustained growth is possible as long as $n_0 > \tilde{n}$ holds.[3] Along the same lines, Figure 1-3 illustrates the case wherein $J > 0$, $Y < 0$, and $Z > 0$. As shown in Figure 1-3, economic growth stops at n^*: the economy does not grow under $n_0 \geq n^*$.[4]

[Figure 1]

To characterize these three cases, it is worth focusing on the relation between β and τ (See Figure 2 where the three lines represent $J = 0$, $Y = 0$, and $Z = 0$, respectively). Table 1 presents the characteristics of regions (A), (B), and (C). Region (A), where $J < 0$, $Y > 0$, and $Z > 0$, corresponds to Figure 1-1. Region (B), where $J > 0$, $Y < 0$, and $Z < 0$, corresponds to Figure 1-2. Region (C), where $J > 0$, $Y < 0$, and $Z > 0$, corresponds to Figure 1-3.[5]

[Figure 2 and Table 1]

The following proposition can be stated.

Proposition 1

- *For an economy where (τ, β) is in region (A) and $n_0 > n^*$, sustained growth is possible (see Figure 1-1).*
- *For an economy where (τ, β) is in region (B) and $n_0 > \tilde{n}$, sustained growth is possible (see Figure 1-2).*
- *For an economy where (τ, β) is in region (C) and $\tilde{n} < n_0 < n^*$, the number of varieties converges to n^* (see Figure 1-3).*

A sufficiently small β implies that the economy is in region (B) or (C); that is, Y is negative. Recall that β is larger than one. In these regions, τ is negative, which represents the subsidy. An intuitive explanation of (B) and (C) can be given as follows. When the government pays a subsidy to manufacture differentiated products, the labor demand for production is large enough. In region (C), this concentrates labor on production, and as a result, economic growth ceases. However, the larger the subsidy, the lower is the consumer price for goods. Households then reduce leisure time and consume more goods. This increases labor supply. In region (B), labor can be allocated to R&D activities and thus sustained growth becomes possible.

[2]When $\beta > 2$, $\frac{1+\tau}{2-\beta} J > \frac{1+\tau}{a} \bar{L} > Z$ holds. Therefore, $n^* > \hat{n} > \tilde{n}$ holds. In contrast, $1 < \beta < 2$ implies that $n^* > \hat{n}$ and $E > 0$. Thus, there is no need to consider the value of $\tilde{n}$.

[3]Since $Y < 0$ implies that $1 < \beta < 2$, $\frac{1+\tau}{a} \bar{L} > \frac{1+\tau}{2-\beta} J$ holds. Hence, we have $\tilde{n} > \hat{n}$.

[4]Because $Y < 0$, $\frac{1+\tau}{2-\beta} < 1$ holds. This implies that $\frac{1+\tau}{2-\beta} J > Z$ and $n^* > \tilde{n}$ hold.

[5]We omit the case where $J < 0$, $Y > 0$, and $Z < 0$ because $g = 0$ holds for all n.

The result in region (C) is different from that of Futagami and Doi (2004), where each household supplies one unit of labor inelastically and the tax/subsidy affect only the labor demand for production and not the labor supply. Futagami and Doi (2004) exhibits scale effects, that is, a large labor supply delivers a high growth rate. In this model, in contrast, even if households' total time is quite large, a small subsidy can halt economic growth.

4 Effects of commodity taxation

In this section, we investigate the effects of commodity taxation on economic growth. By differentiating equation (16) with respect to τ, we obtain

$$\frac{\partial g}{\partial \tau} = -\frac{J}{Y^2} - \frac{FK}{\sigma(1+\tau)Y^2} n^{-\frac{1}{(\beta-1)\sigma}}, \tag{19}$$

where $K \equiv (1+\tau) - (\sigma+1)(2-\beta)$. The sign of $\frac{\partial g}{\partial \tau}$ depends on the signs of J and K, and the value of n. To study the effects of commodity taxation on economic growth, we consider regions (A), (B), and (C).

Region (A): $J < 0$, $Y > 0$, and $Z > 0$. When $K > 0$, the sign of $\frac{\partial g}{\partial \tau}$ depends on the value of n. Let n' be the number of varieties at which $\frac{\partial g}{\partial \tau} = 0$. From (19), n' is defined as follows:

$$n' \equiv \left[-\frac{FK}{\sigma(1+\tau)J} \right]^{(\beta-1)\sigma}.$$

Hence, when $n \lesseqqgtr n'$, $\frac{\partial g}{\partial \tau} \lesseqqgtr 0$ holds. Next, we examine whether n' is larger than n^*. We calculate the following difference:

$$(n')^{\frac{1}{(\beta-1)\sigma}} - (n^*)^{\frac{1}{(\beta-1)\sigma}} = -\frac{1}{a}(1+\tau)^{\frac{1}{\sigma}} \left(\frac{\beta}{\beta-1} \right)^{\frac{1}{\sigma}} \left(\frac{YR}{\sigma JZ} \right), \tag{20}$$

where $R \equiv \frac{1+\tau}{a}\bar{L} - (\sigma+1)(\beta-1)\rho$. Therefore, $R \gtreqqless 0$ implies that $n' \gtreqqless n^*$.

Figure 3-1 shows how the economy responds to an increase in the commodity tax rate when $R > 0$. The locus of g, which represents equation (16), shifts down if $n^* < n < n'$ and shifts up if $n > n'$. Figure 3-2 shows how the economy responds to an increase in the commodity tax rate when $R < 0$. The locus of g shifts up if $n \geq n^*$. Furthermore, $K < 0$ implies that $\frac{\partial g}{\partial \tau} > 0$; that is, the locus of g shifts up. This case also corresponds to Figure 3-2. From the above discussion, region (A) can be divided into regions (A-1) and (A-2) (see Figure 4 in which $K = 0$ and $R = 0$ are added to Figure 2). Besides, Table 2 presents the characteristics of regions (A-1) and (A-2). Regions (A-1) and (A-2) correspond to Figures 3-1 and 3-2, respectively.

[Figures 3, 4 and Table 2]

Region (B): $J > 0$, $Y < 0$, and $Z < 0$. From Figure 4 and Table 2, the region (B) implies $K < 0$ and $R < 0$. Therefore, from (19), $n \lesseqgtr n'$ implies $\frac{\partial g}{\partial \tau} \gtreqless 0$. This case can be illustrated as in Figure 5 which shows how the economy responses to a reduction in the subsidy. The locus of g shifts up if $\tilde{n} < n < n'$ and shifts down if $n > n'$.

[Figure 5]

Region (C): $J > 0$, $Y < 0$, and $Z > 0$. From Figure 4 and Table 2, region (C) implies that $K < 0$. From (19), $\frac{\partial g}{\partial \tau} \gtreqless 0$ holds when $n \lesseqgtr n'$. Next, we reexamine whether n' is larger than n^*. From (20), $R \gtreqless 0$ implies that $n' \gtreqless n^*$.

Figure 6-1 shows how the economy responds to a decrease in the subsidy when $R > 0$. The locus of g shifts up if $\tilde{n} < n < n^*$; a fall in the subsidy raises the growth rate and the number of varieties in the steady state. Figure 6-2 shows how the economy responds to a decrease in the subsidy when $R < 0$. The locus of g shifts up if $\tilde{n} < n < n'$ and shifts down if $n' < n < n^*$. If n is sufficiently small, a decrease in the subsidy increases the short-run growth rate and decreases the long-run growth rate. In addition, the number of varieties in the steady state becomes small. From the above discussion, region (C) can be divided into regions (C-1) and (C-2) (See Figure 4). Regions (C-1) and (C-2) correspond to Figures 6-1 and 6-2, respectively.

[Figure 6]

The following proposition can be stated.

Proposition 2

Suppose that n_0 is sufficiently small and satisfies $\dot{n} > 0$.

- *For an economy where (τ, β) is in region (A-1), when the government increases the commodity tax rate, the short-run growth rate decreases and the long-run growth rate increases (see Figure 3-1). If (τ, β) is in region (A-2), in contrast, an increase in the commodity tax rate raises the growth rate (see Figure 3-2).*

- *For an economy where (τ, β) is in region (B), a decrease in the subsidy increases the short-run growth rate and decreases the long-run growth rate (see Figure 5).*

- *For an economy where (τ, β) is in region (C-1), when the government lowers the subsidy, the growth rate increases and the number of varieties in the steady state becomes high (see Figure 6-1). If (τ, β) is in region (C-2), in contrast, a decrease in the subsidy increases the short-run growth rate and decreases the long-run growth rate. Furthermore, the number of varieties in the steady state becomes low (see Figure 6-2).*

The result in region (A-2), which corresponds to Figure 3-2, is the same as that in Futagami and Doi (2004). However, Figure 3-1 shows that the result in region (A-1) is different. In region (A-1), the commodity tax is larger than in region (A-2) (see Figure 4). When the commodity tax is larger, households prefer leisure to consumption. An intuitive explanation can be given as follows. When the government raises the commodity tax, households' demand for consumption goods decreases, and leisure time increases. Because the latter effect is larger, the short-run growth rate declines. From (14), however, the larger the number of varieties, the lower the price index. Households reduce the leisure time and consume more goods. Thus, the effect of labor supply becomes negligibly small. An increase in the commodity tax rate decreases the demand for consumption goods and reallocates labor from production to R&D. Consequently, this leads to the higher long-run growth rate. In addition, region (A-1) is relatively large if households put weight on leisure. This is captured by the following fact. From the leisure utility function of (1), a small σ makes the households' leisure utility high. When σ decreases, $R = 0$ shifts up and $K = 0$ shifts down as shown in Figure 4.[6] Therefore, a smaller σ implies a larger region (A-1).

An intuitive explanation of the result in region (B), which corresponds to Figure 5, is as follows. A fall in the manufacturing subsidy raises leisure time and reduces the labor demand for consumption goods. Since the latter effect is larger, the reallocation of labor increases the growth rate in the short run. As argued above, the large number of varieties implies a low leisure time, and as such, the effect of labor supply becomes negligibly small. However, a decrease in the manufacturing subsidy lowers the growth rate in the long run (this is contrary to Futagami and Doi (2004)). The underlying reasoning is that when the government decreases the subsidy, households expand their expenditure to avoid a reduction in their utility from the consumption of goods. Hence, the labor demand for production increases and R&D declines. This results in the lower long-run growth rate. The mechanism behind the result in region (C-2), corresponding to Figure 6-2, is the same as that behind (B). In contrast, the mechanism behind the result in region (C-1), which corresponds to Figure 6-1, applies to only the short-run mechanism in region (B).

5 Conclusion

In this note, we have analyzed the effects of commodity taxation and a manufacturing subsidy in a variety expansion model with endogenous labor supply. The main results are as follows. First, when the government raises the commodity tax, households reduce labor supply. This

[6] From the definition of J, Y and Z, these values are independent of σ.

can lower the growth rate in the short run if households prefer leisure. Second, if the elasticity of substitution and the subsidy are sufficiently small, economic growth ceases. Third, when the government reduces the subsidy, the short-run growth rate increases and the long-run growth rate decreases.

Appendix

A.1 Condition $\bar{L} - l > 0$

From (10), (14), and the definition of F, condition $\bar{L} - l > 0$ is given by

$$\frac{1+\tau}{a}\bar{L} - Fn^{-\frac{1}{(\beta-1)\sigma}} > 0.$$

When $\dot{n} > 0$, this equation must be concluded at time 0,

$$n_0 > \hat{n} \equiv \left\{ \frac{a}{(1+\tau)\bar{L}} F \right\}^{(\beta-1)\sigma}.$$

A.2 Condition $E > 0$

$\beta > 2$ implies that $J < 0$ and $Y > 0$. From (18), condition $E > 0$ is given by

$$-(1+\tau)J + (2-\beta)Fn^{-\frac{1}{(\beta-1)\sigma}} > 0.$$

When $\dot{n} > 0$, this equation must be concluded at time 0,

$$n_0 > \tilde{n} \equiv \left\{ \frac{(2-\beta)F}{(1+\tau)J} \right\}^{(\beta-1)\sigma}.$$

If $1 < \beta < 2$, the signs of J and Y are ambiguous. When $J < 0$ and $Y > 0$, obviously, $E > 0$. When $J > 0$ and $Y < 0$, condition $E > 0$ can also be given as $n_0 > \tilde{n}$. However, when J and Y have the same sign, $E > 0$ must not hold under $\dot{n} > 0$.

References

[1] Devereux.M and Love.D.R.F (1994) The effects of factor taxation in a two-sector model of endogenous growth, Canadian Journal of Economics, Vol.27, pp.509-536.

[2] King.R.E and Rebelo.S (1990) Public policy and economic growth: developing neoclassical implications, Journal of Political Economy, Vol.98, pp.S126-S150.

[3] Futagami.K and Doi.J (2004) Commodity taxation and economic growth, Japanese Economic Review, Vol.55, pp.46-55.

[4] Grossman.G.M. and Helpman.E (1991) Innovation and growth in the global economy. Cambridge, Mass.: MIT Press.

[5] Jorgenson.D.W (1998) The growth-boosting power of a consumption tax, in J.Jasinowski (ed.), The rising tide, New York: John Wiley, pp.223-229.

[6] Milesi-Ferretti.G.M and Roubini.N (1998) Growth effects of income and consumption taxes, Journal of Money, Credit and Banking, Vol.30, pp.721-744.

[7] Pecorino.P (1993) Tax structure and growth in a model with human capital, Journal of Public Economics, Vol.52, pp.251-271.

[8] Rebelo.S (1991) Long-run policy analysis and long-run growth, Journal of Political Economy, Vol.99, pp.500-521.

[9] Stokey.N.L Rebelo.S (1995) Growth effects of flat-rate taxes, Journal of Political Economy, Vol.103, pp.519-550.

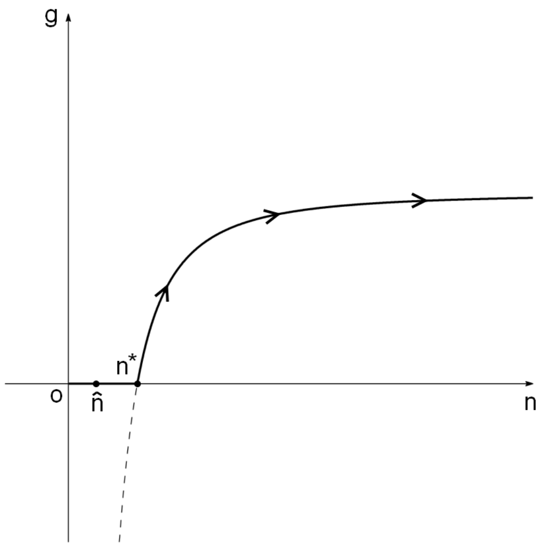

Figure 1-1

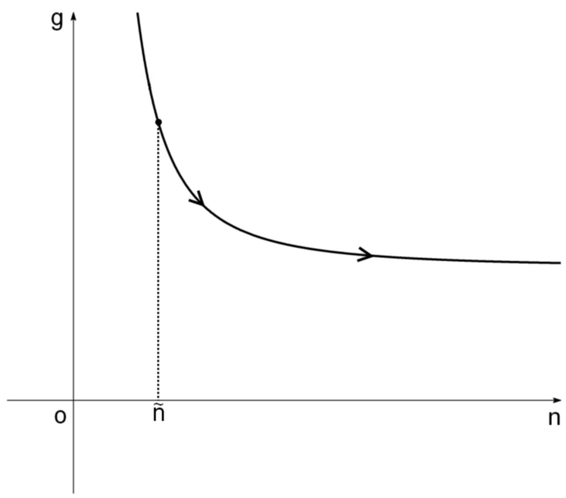

Figure 1-2

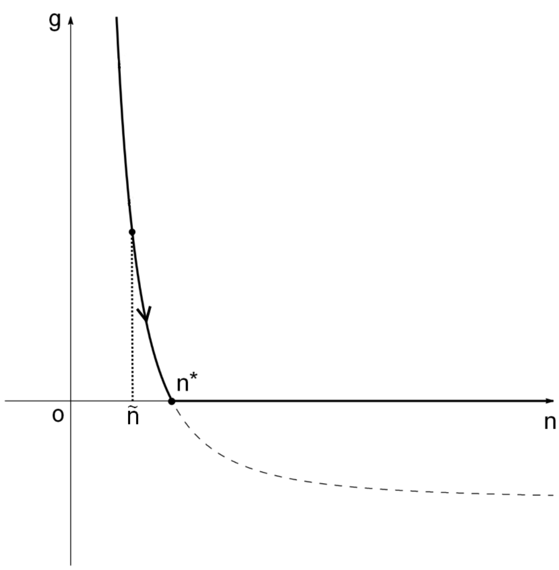

Figure 1-3

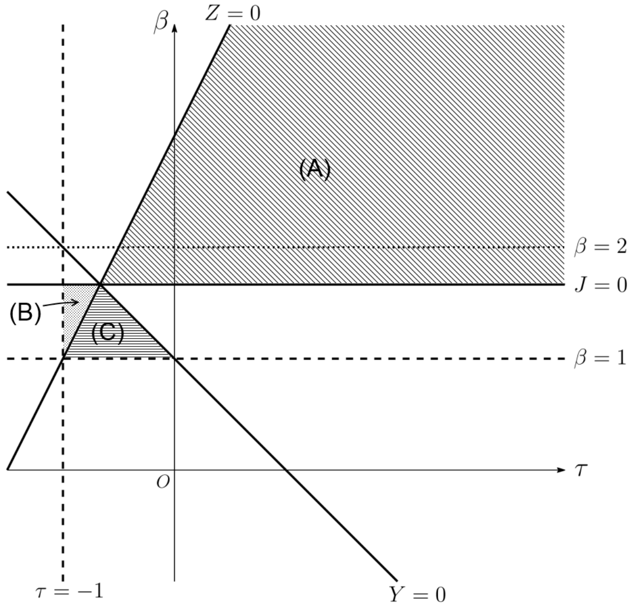

Figure 2

	(A)	(B)	(C)
J	$-$	$+$	$+$
Y	$+$	$-$	$-$
Z	$+$	$-$	$+$

Table 1

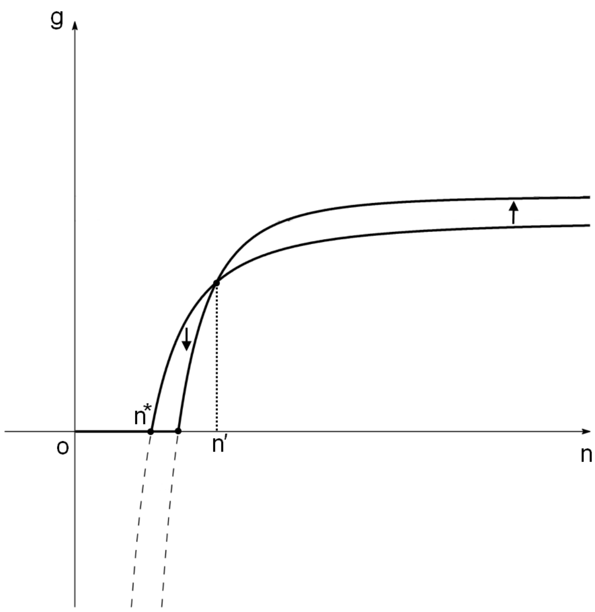

Figure 3-1

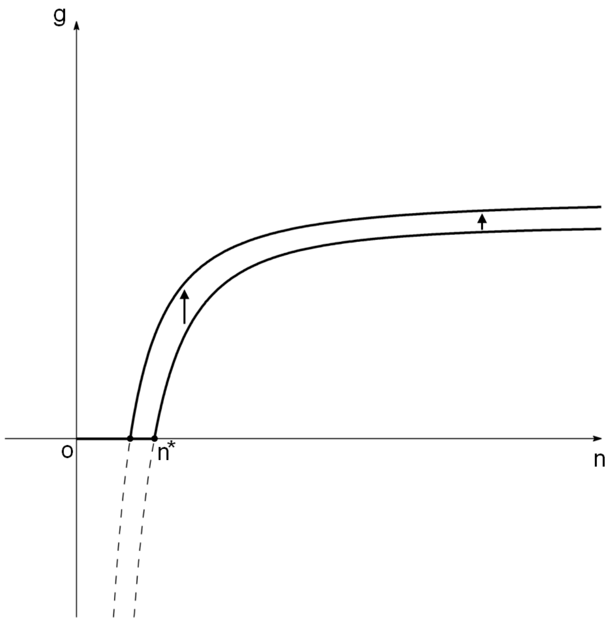

Figure 3-2

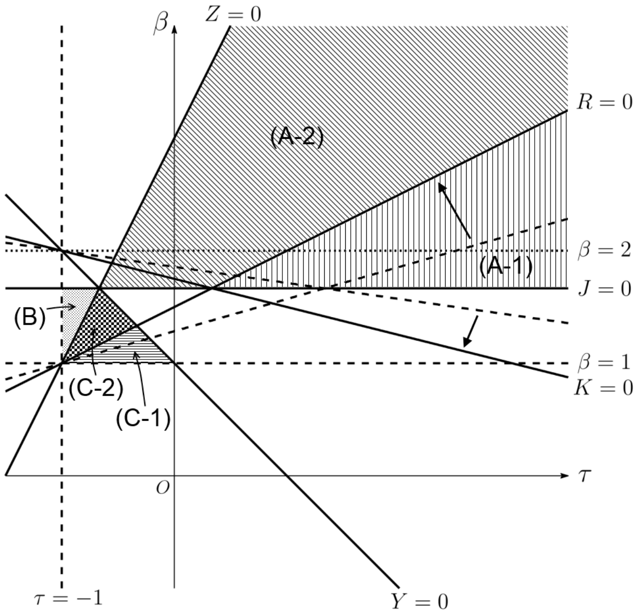

Figure 4 : the shift represents lowering σ

	(A-1)	(A-2)	(B)	(C-1)	(C-2)
J	$-$	$-$	$+$	$+$	$+$
Y	$+$	$+$	$-$	$-$	$-$
Z	$+$	$+$	$-$	$+$	$+$
K	$+$	$\pm$	$-$	$-$	$-$
R	$+$	$-$	$-$	$+$	$-$

Table 2

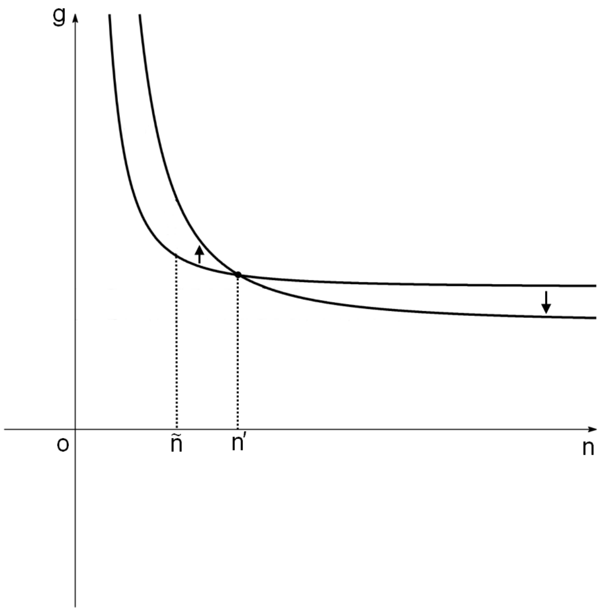

Figure 5

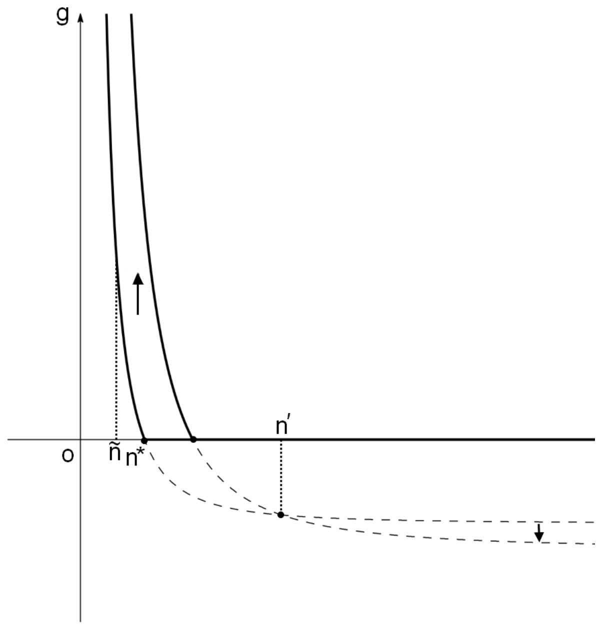

Figure 6-1

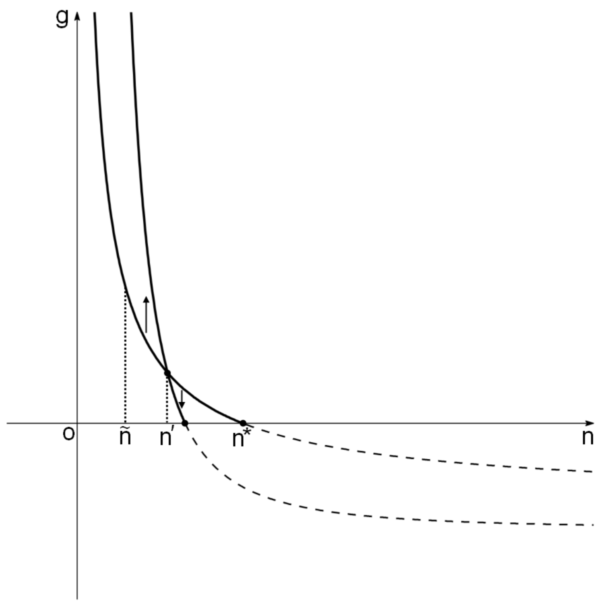

Figure 6-2