Growth Regimes in Japan and the United States in the 1990s

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Résumé
Régimes de croissance au Japon et aux États-Unis dans les années 1990
À partir du concept kaldorien de « causalité cumulative », on peut identifier les causes de la stagnation au Japon et de la croissance économique élevée aux États-Unis durant les années 90. À cette fin, nous commençons notre étude par une analyse descriptive des régimes de productivité du travail et de la norme de consommation. En suite, nous estimons séparément ces régimes dans ces deux pays, durant deux périodes : les années 80 et les années 90.Selon notre évaluation, on observe une contraction de la dynamique de la demande au Japon qui est à l’origine de la stagnation. Aux États-Unis, on constate à la fois une augmentation du régime de demande et de productivité qui explique les niveaux élevés de la croissance. Les causes des modifications des régimes sont en suite clarifiées par l’analyse empirique.

Mots clé
Régime de demande, régime de productivité, effet cumulatif, modèle de croissance de Baumol

Abstract
Based on Kaldor’s concept of ‘cumulative causation’, the causes of the economic stagnation in Japan and the high economic growth in the United States in the 1990s are clarified. For this purpose, we formalize mathematically and descriptively two-way routes between labour productivity growth and demand growth; these routes are known as ‘demand regime’ and ‘productivity regime’. Next, we separately estimate these regimes in these two countries, for two periods: the 1980s and the 1990s. According to our estimation, a leftward shift of the demand regime led to the economic stagnation in Japan in the 1990s, and a rightward shift of the demand regime and an increase in the slope of the productivity regime led to the high economic growth in the United States. The causes of these shifts have been empirically clarified.

Key word
demand regime; productivity regime; cumulative causation; Baumol’s growth model

JEL classification: E11, O41, O47

Pour citer cet article

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1. Macroeconomic performance and two-sector dynamics

Table 1 shows the main indicators of economic performance in both Japan and the United States in the 1980s and the 1990s. Although the low growth rate of real GDP in Japan in the 1990s is prominent, the low growth rate of investment is even more remarkable. Non-residential investment decreased in Japan in the 1990s. The stagnation of demand represented by investment demand was related to a slowdown in employment growth. The average growth rate of total employment in Japan in the 1990s was only 0.4%. Total employment began to decline from 1998. Further, manufacturing employment decreased by 1.7% annually in the 1990s, and the so-called de-industrialization progressed rapidly. On the other hand, although manufacturing employment in the United States began to decrease earlier than in Japan, the decrease rate declined in the 1990s. Thus, although economic performance in Japan exceeded that in the United States in the 1980s, it reversed in the 1990s. With regard to price change, a gradual deflation occurred in Japan in the latter half of the 1990s.

Due to the economic stagnation in Japan in the 1990s, this decade is referred to as the ‘lost decade’. There arose a controversy regarding the cause of this stagnation between the neoclassical school and the Keynesian school. Hayashi and Prescott (2002), who belong to the former school, attributed it to the decrease in total factor productivity, while Yoshikawa (2002), who belonged to the latter school, attributed it to the shortage in demand. However, this controversy is unproductive for the following reasons. The neoclassical theory has a theoretical structure in which economic fluctuations can only be explained from the supply side and the influence of demand change on productivity change is not admitted. Conversely, the Keynesian theoretical structure is designed such that it begins with an independent change in investment demand and tends to ignore the influence of productivity change on demand change.

This paper clarifies the causes of the economic stagnation in Japan and the economic growth in the United States in the 1990s, based on the idea of ‘cumulative causation’ proposed by Kaldor (1966, 1970) as a mutual relationship between labour productivity growth and demand growth. This paper is organized as follows: In this section, we explain that the macroeconomic situation shown in Table 1 related to the sectoral dynamics in the consumer goods sector and the investment goods sector. Further, based on the growth model of Baumol (1967), we show that demand growth and labour productivity growth in the investment goods sector are important.

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for macroeconomic growth. Kaldor’s description regarding the contents of the route from demand growth to productivity growth and vice versa is insufficient. Section 2 clarifies various factors, including institutional factors, that influence these two routes, which are also referred to as ‘demand regime’ and ‘productivity regime’. It also formalizes these routes mathematically and descriptively. In section 3, demand regimes in Japan and the United States are estimated separately for two periods, the 1980s and the 1990s. In section 4, productivity regimes are estimated in a similar manner. Based on these estimations, the cause of the economic stagnation in Japan in the 1990s is clarified as changes in these two regimes. Consequently, we can resolve the above-mentioned unproductive controversy between the neoclassical school and the Keynesian school. In addition, the cause of the high economic growth in the United States in the 1990s is clarified. Section 5 presents a summary of the main findings of this study.

**Table 1. Macroeconomic performance**

<table>
<thead>
<tr>
<th>Japan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>4.0</td>
</tr>
<tr>
<td>Real non-residential investment</td>
<td>6.7</td>
</tr>
<tr>
<td>Total employment</td>
<td>0.9</td>
</tr>
<tr>
<td>Manufacturing employment</td>
<td>0.9</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Annual growth rate, unit: %
The bias of the business cycle in the measurement is small because the years 1980, 1990 and 2000, the business cycle was near its peak in these two countries.

Sources: Japan: Ministry of Internal Affairs and Communications, *Annual Report on National Accounts (ARNA)*.

The macroeconomic situation shown in Table 1 is associated with the two-sector dynamics shown in Table 2. The growth rate of labour productivity in the investment goods sector exceeds that in the consumer goods sector in both Japan and the United States. The non-residential private investments comprise machinery investment and construction investment. The machinery manufacturing sector witnessed a considerable increase in labour productivity, although this is not indicated in Table 1. In particular, the labour productivity in the computer manufacturing sector increased significantly, owing to the influence of the rapid progress in IT.

The sectoral growth rates of demand differ greatly between Japan and the United States. The growth rate of the demand for investment goods exceeds that of the demand for consumption goods in the United States. However, in Japan the growth rate of the demand for investment goods is negative and that of the demand for consumption goods is positive. Moreover, as shown in Table 2, the pattern of price change is also different between these two countries. In the United States, there was a slight change in the prices of investment goods, whose productivity grew rapidly and an increase in the prices of consumer goods, whose productivity grew slowly. As a result, the price index of all goods rose and a gradual inflation occurred in the
whole economy. However, in Japan the prices of consumer goods did not change to a large extent and the prices of investment goods decreased.

Table 2. Sectoral dynamics

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-residential</td>
<td>Consumer goods</td>
</tr>
<tr>
<td>productivity</td>
<td>investment goods</td>
<td>investment goods</td>
</tr>
<tr>
<td>Labour</td>
<td>2.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Real final</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>demand</td>
<td>−1.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Price</td>
<td>−1.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Nominal</td>
<td>1.1</td>
<td>3.7</td>
</tr>
<tr>
<td>wage rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Annual growth rate, unit: %
The growth rates of the labour productivity of non-residential investment goods and consumer goods were calculated by the following procedures. The product of the Leontief inverse matrix and the labour input coefficient vector is a vector whose element shows the amount of labour directly and indirectly necessary to produce one unit of each commodity, which Pasinetti (1973) called 'vertically integrated labour input coefficient'. In addition, we calculated the weighted average of the vertically integrated labour input coefficients as follows. In the case of consumer goods, the weight is the composition ratio of various commodities that compose the consumption expenditure. The decreasing rate of this average value is assumed to be the growth rate of the labour productivity of consumer goods.

Sources: Japan: Ministry of Internal Affairs and Communications, *The Linked Input-Output Tables in 1990–1995–2000* and *ARNA.*

Using the two-sector model of Baumol (1967), the relationship between the macroeconomic growth and the sectoral growth of productivity and demand can be explained as follows. If the composition ratio of real sectoral demand does not change in an economy with disproportionate productivity growth, then employment would gradually concentrate on a sector with low productivity growth and the macroeconomic growth would decelerate. This scenario is presented as case 1 in Table 3. In a situation where the growth rate of demand for a commodity with low productivity growth is relatively high, for instance, Japan in the 1990s, there is a rapid slowdown in macroeconomic growth. In other words, this type of structural change in demand leads to a slowdown in economic growth. Conversely, as shown in case 2 in Table 3, if the growth rate of demand for a commodity with high productivity growth is relatively high, then there would be a negligible change in the composition ratio of employment by sector and the macroeconomic growth rate could be maintained. This is similar to the case of the United States, as shown in Table 2.
Table 3. Two typical cases in Baumol’s two-sector model

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour productivity growth</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Final demand real growth</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Employment growth</td>
<td>–</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Macroeconomic growth</td>
<td>Slowdown</td>
<td>Sustained</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Productivity gap deflation and inflation

<table>
<thead>
<tr>
<th></th>
<th>Productivity gap deflation</th>
<th>Productivity gap inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sector 1</td>
<td>Sector 2</td>
</tr>
<tr>
<td>Productivity growth</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Nominal wage growth</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Price change</td>
<td>–</td>
<td>0</td>
</tr>
<tr>
<td>Aggregated price change</td>
<td>–</td>
<td>+</td>
</tr>
</tbody>
</table>

*If sector 2 is the consumer goods sector, the real wage growth is equal to ‘+’ in both cases.*

In addition, changes in the aggregated price can also be explained by sectoral dynamics. To simplify the explanation, we adopt the following assumptions. First, the price of the i-th good (p_i) is assumed to be the product of the vertically integrated labour coefficient (Γ_i), the uniform wage rate (w) and the profit mark-up (1+m). Second, it is assumed that the mark-up rate (m) is constant and that the vertically integrated labour coefficient decreases through time. The decrease rate of the vertically integrated labour coefficient is the growth rate of labour productivity.

\[ \begin{align*}
P_1 & = v_1 w (1+m) \\
P_2 & = v_2 w (1+m_2)
\end{align*} \]

Under these assumptions, two cases result depending on the method used for wage indexation; indexation of the wage rise to the productivity growth in sector 1 or indexation of the wage rise to the productivity growth in sector 2. In the first case, if the growth rate of wages is equal to the relatively high growth rate of productivity in sector 1, then the product price in sector 1 will not change. However, the product price in sector 2 will increase because the growth rate of wages exceeds the growth rate of productivity in sector 2. Thus, the aggregated price index in the whole economy will increase. Takasuka (1962) named this phenomenon ‘productivity gap inflation’. This is applicable to the gradual inflation in the United States, as shown in Table 2. In the second case, if the growth rate of wages is equal to the relatively low growth rate of productivity in sector 2, then the product price in sector 2 will remain unchanged; however, the product price in the sector 1 will decrease because the growth rate of wages is lower than the growth rate of productivity in sector 1. Thus, contrary to the first case, the aggregated price index in the whole economy decreases,
resulting in ‘productivity gap deflation’. This is applicable to the gradual deflation in Japan, as shown in Table 2. Table 4 summarises these two typical cases.

In the 1990s, Japan was in a situation similar to case 1 in Table 3 and was experiencing productivity gap deflation. On the other hand, the situation in the United States was akin to case 2 in Table 3 and the country was experiencing productivity gap inflation. Although conventional logic admits the possibility of other combinations, the sluggish demand for investment goods, as shown in case 1 in Table 3, is associated with a decrease in the prices of investment goods in the case of productivity gap deflation, as will be discussed in section 3.3.

In the following analysis, we focus on the change in productivity and demand in the investment goods producing sector, specifically, its machinery manufacturing sector and construction sectors in the standard industry classification. In this sector in the United States, the 1990s witnessed a higher growth than before in both productivity and demand; however, in Japan, both were lower than before. The causes of these changes are examined in the following sections.

2. Formalization of growth regimes

2.1. Stages in cumulative causation

In order to sustain macroeconomic growth, a relatively high growth rate of the demand for commodities with high productivity growth is a necessary condition. Based on Kaldor’s concept of cumulative causation, this condition implies that the effects of productivity growth on demand growth and vice versa are considerable in the case of such commodities. Boyer (1988) labelled the route from productivity growth to demand growth as ‘demand regime’ and that from demand growth to productivity growth as ‘productivity regime’. Using a macroeconomic model, he derived the function that expresses each regime. He also explained the transformation of the growth regime through the shift of these two functions. In this paper, we give priority to the explanation of the process of cumulative causation that operates within each regime taking into account institutional factors. In order to clarify the mechanism of these effects, we divide each regime into two stages, as shown in Figure 1.

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3 The model of Boyer (Boyer, 1988) is developed in Boyer (Boyer, 2004b) and Petit (Petit, 2005). Although Boyer’s model is a one-sector model, Uni (Uni, 1988) derived the demand and productivity regime functions from a two-sector model with productivity gap. Naastepad (Naastepad, 2006) estimated demand and productivity regimes in the Netherlands.
2.2. Formalization of demand regimes

The route from productivity growth to demand growth comprises two stages, namely, income distribution and income expenditure. In this study, we examine income distribution in terms of the distribution of productivity gains. For instance, in some cases, it could be mainly distributed as either wage rise or profit rise. Moreover, it could be distributed evenly as both or as a decrease in commodity price benefiting purchasers (Petit, 2005). An important factor affecting this distribution selection is wage institutions, which vary by country and can be either centralised or decentralised bargaining. At this point, it is important to note that wage institutions in advanced countries guarantee wage equality to some extent, even in countries that have required decentralised bargaining, such as Japan. In wage bargaining within Japanese companies, the results of negotiations in other companies are often referred. Wage determination is not a closed process within a company but is related to the macroeconomic dimension. Moreover, free capital transfer realizes equality of the profit rate to some extent. Thus, income distribution has a macroeconomic dimension, as a result of which the demand regime is a concept defined chiefly at the macroeconomic level.

The second stage of the demand regime is expenditure of the distributed income. The wage and profit incomes are expended as consumption or investment. The amount of each expenditure depends on various factors such as the amount of income, the price of the commodity and the availability of credits. Moreover, it is a known fact that these factors especially affect investment and that its changes are very significant.

Next, using a very simple two-sector growth model, we formalize the demand regime. In the model of Boyer (1988) that formalized growth regimes for the first time by using the Keynesian-type independent investment function and independent consumption function, the demand constraint was assumed. Although the demand constraint is usually incorporated in short-term models, Boyer intentionally adopted it in a long-term model (Boyer, 2004b). Duménil and Lévy (2003) criticized this assumption from the Marxian viewpoint. They insisted that the crisis of American capitalism in the inter-war period and its growth in the post-war period were not the results of demand changes but of technological and organizational changes. In this section, we assume neither the independent investment function nor the independent consumption function and propose an analytical framework by which both demand changes and technological and organizational changes can be examined. In the rest of this section, by expanding identical equations, we derive a linear relationship between demand growth and productivity growth, that is, the
demand regime function. (The independent investment function is introduced at the stage of the estimation of the demand regimes in section 4).
The total real demand in the investment goods sector ($Y_1$): concretely, the sum of the demand for the machinery manufacturing sector and the construction sector) comprises the capital investment of enterprises ($I$), household consumption of machinery and residential construction ($C_1$) and exports of machinery ($E_i$), in the following manner:

$$Y_1 = I + C_1 + E_i$$  

(3)

Prices are expressed by the previously shown equations (1) and (2). The prices of investment goods is $P_1$. When $\Pi$ denotes the total profit income in the whole economy and $S$ denotes the saving rate of the profit income (the proportion of the amount of investment in the profit income), it follows that

$$p_1I = s\Pi$$  

(4)

Moreover, we assume that all wage and profit incomes that are not invested are consumed. When $B$ denotes the ratio of household machinery consumption and residential investment in the above-mentioned total disposable income, and $L$ denotes the amount of total labour, it follows that

$$p_1C_1 = \beta[WL + (1 - s)\Pi]$$  

(5)

From equations (4) and (5), the following can be stated:

$$I + C_1 = (\Pi / p_1)(1 - \beta)S + \beta / \pi = \left[ (p_1Y_1 + p_2Y_2)\pi / p_1 \right] \{(1 - \beta)s + \beta / \pi \}

= (Y_1 + p_1Y_2 / p_1)(1 - \beta)s + \beta / \pi$$  

(6)

Here, $\pi = \Pi / (\Pi + wL)$ denotes the profit share and $Y_2$ denotes the total demand for consumer goods.

$\rho_1, \rho_2$ denote the decreasing rates of vertically integrated labour coefficients, that is, the growth rates of labour productivity, as shown in equations (7) and (8). Moreover, $\Delta$ denotes the sectoral differential of the mark-up change. Hereafter, a variable with a hat sign shows the change rate of this variable, and a variable with a bar sign shows the average of this variable during the period.

$$\rho_1 = \dot{v}_1$$  

(7)

$$\rho_2 = \dot{V}_2$$  

(8)

$$\Delta = (1 + m_1) - (1 + m_2)$$  

(9)

From equations (1), (2), (7), (8) and (9), the following equation is derived:

$$\hat{\rho}_2 - \hat{\rho}_1 = \rho - \hat{\rho}_2 - \Delta$$  

(10)

From equations (3), (6) and (10), the growth rate of the demand for investment goods ($\dot{g}_1$) is derived as follows:

$$g_1 = \dot{H}_1 : \d(\dot{T} + \dot{C}_1) + (1 - \d)\dot{H}_1 = \d((1 - \sigma)\dot{g}_1 + \sigma(\rho_1 - \rho_2 - \Delta + \dot{Y}_2) + (\Gamma - \beta)s\pi + \beta) + (1 - \d)\dot{H}_1$$  

(11)

Here, $\d = (\dot{T} + \dot{C}_1) / \dot{Y}_1$, $\sigma = \dot{Y}_1P_2 / (\dot{Y}_1P_1 + \dot{Y}_2P_2)$

As shown later in section 3.2, the ratio of household machinery consumption and residential investment to the total disposable income ($\dot{B}$) has been almost constant when considered from a long-term perspective. When $\dot{B}$ is constant, it follows that

$$(\Gamma - \beta)s\pi + \beta = \tau(\dot{s} + \dot{x})$$  

(12)

Here, $\tau = (1 - \beta)s\pi / [(1 - \beta)s\pi + \beta]$
Moreover, when $L_{2}$ denotes the amount of labour in the consumer goods sector, then,

$$L_{2} = \hat{Y}_{2} - \rho_{2}$$  \hspace{1cm} (13)

After substituting equations (12) and (13) in equation (11), the following equation is derived:

$$g_{1} ; z\delta \sigma_{1} + z\delta \sigma \hat{L}_{2} + z\delta r \hat{s} + z\delta \tau \hat{\pi} - z\delta \sigma \Delta + z(1 - \delta)\hat{E}_{1}$$  \hspace{1cm} (14)

Here, $\delta = 1/[1(1 - \sigma)]$

Equation (14) is the demand regime function in the investment goods sector. The slope of this function is $z\delta \sigma = \delta \sigma /[1 + \delta \sigma]$, where clearly $\delta$ represents the ratio of domestic demand to the total investment goods demand; therefore, the first term on the right-hand side of equation (14) shows the effect of the domestic distribution of productivity gains on the demand for investment goods. The intercept of this function consists of five elements. The meaning of each element is as follows. The second term in this equation shows the effect of an employment increase in the consumer goods sector on the demand for investment goods. The third term shows the effect of a change in the saving rate of the profit income, and the fourth term shows the effect of a change in the profit share. The fifth term shows the effect of a sectoral differential of the mark-up change. For instance, as shown in equation (10), when the mark-up change in the investment goods sector exceeds that in the consumer goods sector, there is a decline in the decreasing rate of the relative prices of investment goods due to the productivity gap. This has a negative influence on the demand for investment goods. The sixth term represents the effect of a change in the foreign demand.

A majority of the terms depend on the income distribution and the expenditure structure in the whole economy. Here, the demand regime function shows a constraint between demand growth and productivity growth that acts at the macroeconomic level. The Cambridge equation ($g = \sigma r$) is well known as a dynamic constraint in economic growth. This equation focuses on the relationship between income distribution and economic growth. However, from the middle- and long-term perspectives it is also important to focus on the relationship between productivity growth and economic growth. The demand regime function is merely an enhanced version of the Cambridge equation that enables us to focus on the relationship between productivity growth and economic growth.

2.3. Formalization of productivity regimes

In this section, we examine the route from demand growth to productivity growth. Now, assume that the demand for a certain commodity has increased. The enterprise that produces this commodity attempts to increase the amount of output in order to meet this increase in demand. The main methods employed by this enterprise are adjustments of capital stock and employment. Since, the adjustment of capital stock generally precedes that of employment, we assume that in the productivity regime, the adjustment of capital stock is the first stage and the adjustment of employment is the second stage.

The adjustment of capital stock involves increasing equipment or raising the utilization rate of existing equipment. However, the latter is only temporarily effective because it can only be adopted when the utilization rate is low. Hence, from a long-term perspective, the former is the main method for the adjustment of capital stock. Generally, at the macroeconomic level, the rate at which the amount of capital stock increases is similar to the rate at which the amount of output increases. As a result, the capital coefficient does not change significantly.
Even though the change in the capital coefficient is not significant, production equipment changes qualitatively along with investment. The qualitative changes in production equipment have continued ceaselessly since the Industrial Revolution. Recently, for instance, the industrial use robot, the NC machine tool and CAD/CAM have spread to the workplace of manufacturing industries. Moreover, the development of optical communication technology has improved the capacity and speed of telecommunication. The development of the Internet technology has improved the accessibility of information. The degree of integration in semiconductors and the processing speed of the CPU rose rapidly according to Moore’s Law, which predicts that they would double in 18–24 months. These changes, collectively known as the ‘TT revolution’, bring a qualitative change in production equipment and make it possible to decrease the amount of labour necessary for producing one unit of a commodity.

In the case where there is no qualitative change in production equipment, the amount of necessary labour ($L_n$) would increase at the same rate as the output growth ($g$). Therefore, in such a case, the elasticity of necessary labour to output is one. Usually, however, new equipment introduced by investment embodies new technology and differs qualitatively from the existing equipment; thus, it enables a reduction in labour. When an increase in production equipment affects the increase rate of necessary labour such that it reduces, the elasticity of necessary labour to output ($\eta_n$) is less than one.

$$\dot{L}_n = \eta_n g - \phi_n$$

(0 < $\eta_n < 1, \phi_n > 0$) \hspace{1cm} (15)

Here, $\phi_n > 0$ because the necessary labour is reduced even when the output growth is zero; this is because of the need to renew equipment whose utility is exhausted.

Next, we consider labour adjustment, which operates in the second stage of the productivity regime. Based on the growth rate of necessary labour shown by equation (15), the extent of employment or the number of working hours is adjusted. Since the number of the working hours can be adjusted only to a limited extent, as is natural, and since such a measure has only temporary effectiveness, we have excluded it from the following explanation. Therefore, the main method of adjusting labour is the adjusting the extent of employment. However, since employment is directly related to a worker’s life, the extent of employment is not a variable that can be freely changed based on the manager’s decision. The flexibility of employment depends on factors such as legislation on employment protection and the power of unions in negotiation. In general, if the dismissal of regular workers is difficult, like it is in Japan, the decrease of employment during recessions would be small and its increase during booms would also be small because managers tend to be cautious about adjusting the extent of employment.

Therefore, the elasticity of actual employment to output ($\eta$) would be less than the elasticity of necessary labour to output ($\eta_n$).

$$\dot{L} = \eta_1 g - \phi$$

(0 < $\eta < \eta_n < 1, \eta / \phi = \eta_n / \phi_n$) \hspace{1cm} (16)

Here, $\eta / \phi = \eta_n / \phi_n$ because institutional effects are inoperative when the change rate of employment is zero.

When $\rho$ denotes the growth rate of labour productivity, then based on the definition $\rho = g - \dot{L}$. Substituting it in equation (16), the relationship between productivity growth and output growth is derived as follows:

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4 For instance, the elasticity of employment to output in the manufacturing industry is approximately 0.2 in Japan, while it is about 0.8 in the United States (Uni, 2000b).
\( \rho = (1 - \eta) g + \phi \quad (0 < 1 - \eta < 1, \phi > 0) \) \hspace{1cm} (17)

This is the ‘productivity regime function’, and its slope is \((1 - \eta)\). While institutions pertaining to income distribution and expenditure structure play a key role in the demand regime, employment institutions and the labour saving effect of new technology play a key role in the productivity regime. In particular, institutions that suppress employment change are of importance. For example, legislations or labour-management agreements on employment protection and the power of labour unions in negotiation affect the slope of the productivity regime function.

Although legislation affects the whole society, the characteristics of new technology, labour-management agreements and the negotiation power of labour unions are specific to an industry or to an enterprise. Therefore, the constraint between productivity growth and output growth, as shown by the productivity regime function, is different based on individual industry and enterprise even in the same country.

3. Estimation of demand regimes

In this section, we estimate the demand regime function in Japan and the United States. Using the model described in section 2.2 and without introducing the independent investment function, the consumption function or the export function, we derived the demand regime function from identical equations pertaining to the supply and demand of two sectors. We also estimate the demand regime function under more realistic assumptions regarding the decision of consumption, investment and export. It should be noted that we estimate the ten-year average position of the demand regime. Since the demand regime is accompanied by short-term fluctuations, due to the vast changes in investment demand corresponding to the business cycle, such cyclical fluctuations are excluded from the following estimation.

In equation (14), the coefficient of \( g_1 \) appears to indicate the slope of the demand regime function. However, to fix the position of the demand regime function, it is necessary to examine the following point. In other words, in equation (14), there is a possibility that some parameters respond to productivity change or price change. For instance, the amount of export may increase when productivity rises and price decreases. In this case, the growth rate of export demand \((E,)_t\) would also be the function of productivity growth \((g_1)\).

In the productivity gap inflation in Japan before 1990 and in the United States, the change in the prices of investment goods was minimal because nominal wages rise along with productivity in the investment goods sector. Therefore, even if some parameters respond to price change, the change in the parameter would be minimal. Consequently, in Japan before 1990 and in the United States, equation (14) approximates the demand regime function.

In the productivity gap deflation in Japan in the 1990s, the high productivity growth in the investment goods sector resulted in a decrease in the prices of investment goods at a similar rate because nominal wages rise slowly along with productivity in the consumer goods sector. Therefore, in this case, it is necessary to clarify the extent of the influence of price change on the parameters in the right-hand side of equation (14). This needs to be reflected in the slope of the demand regime function. Subsequently, we examine the influence of price change on the parameters concerning the export, consumption and investment demands in Japan.
3.1 Influence on the export demand

The real growth rate of the export demand ($\hat{E}_e$) depends on the change rate of the relative price (i.e., the ratio of the dollar based price of Japanese products ($\mathcal{E}P_1$) to international price of their rival products ($P_a$)) and the growth rate of the scale of the international market ($\hat{W}$). When $\mathcal{E}$ denotes the exchange rate and $a_1, a_2$ denote constants, it can be stated as follows:

$$\hat{E} = a_1(P_a / \mathcal{E}P_1) + a_2\hat{W} = a_1(\hat{P}_a - \hat{\mathcal{E}} - \hat{P}_1) + a_2\hat{W}$$  \hspace{1cm} (18)

The actual rate of change in the relative prices of Japanese export goods ($\hat{P}_a - \hat{\mathcal{E}} - \hat{P}_1$) is shown in Figure 2, where a long-term trend does not exist, although there are large short-term fluctuations. Its average value in each decade is 1.9% in 1971–1980, 0.2% in 1981–1990 and 0.1% in 1991–2002, indicating that after the 1980s, in the long run, the price decrease of Japanese products on the basis of the yen has been counterbalanced by the appreciation of the yen. Thus, it can be stated that the theory of purchasing power parity concerning export goods has been effective in the long run. Therefore, in the long run, equation (18) can be represented as $\hat{E} = a_2\hat{W}$. Thus, the actual growth rate of export demand ($\hat{E}_e$) becomes almost irrelevant to price change and productivity growth.

**Figure 2. The actual change rate of the relative price of Japanese export goods ($\hat{P}_a - \hat{\mathcal{E}} - \hat{P}_1$)**

![Graph showing the actual change rate of the relative price of Japanese export goods](image)

Sources: $P_1$ is the export deflator in ARNA and $P_a$ is the export price index of industrialized countries in IMF, *The International Financial Statistics*.

3.2 Influence on the consumption demand

Here, we consider the ratio of household machinery consumption and residential investment to the total disposable income ($\hat{\beta}$). The actual value of $\hat{\beta}$ is shown in Figure 3, where it has been constant from a long-term perspective since 1970 in Japan, although there have been short-term fluctuations\(^5\).

\(^5\) Before 1950, $\hat{\beta}$ had an upward trend in the United States, and the same trend was seen in Japan before 1970. This is because of the diffusion of the so-called Fordist mode of consumption in these
Gershuny (1983) proposed the concept of ‘social innovation’ as a theory that explains the parallel increase in the consumption of services and durable goods in the so-called service economy. On the basis of the data obtained in European countries in the 1970s, he explained that the prices of services \( p_s \) rise faster than those of durable goods \( p_d \) mainly because the growth rate of labour productivity in the service sector is less than that in the durable goods sector. When faced with a relatively high price increase in domestic services, entertainment, transport etc., households change their ‘mode of provision’ for satisfying their needs. For instance, they purchase washing machines, televisions and cars instead of utilising laundry services, cinemas and buses respectively. Gershuny called this change in the mode of provision ‘social innovation’.

Thus, Gershuny’s theory implies that the elasticity of the relative demand to the relative price of durable goods and services is approximately one. When \( \hat{\beta}_1 \) and \( \hat{\beta}_2 \) denote the real growth rate of the demand for durable goods and that of the demand for services respectively, the following equation is derived if this elasticity is one:

\[
\hat{\beta}_1 - \hat{\beta}_2 = -1(\hat{\beta}_1 - \hat{\beta}_2)
\]  

(19)

Thus, \( \hat{\beta}_1 p_1 = \hat{\beta}_2 p_2 \), which shows that the amount of nominal expenditure of durable goods and that of services increase proportionally, and that these two composition ratios do not change. In fact, this elasticity is approximately one in our estimation using the data of Japan and the United States\(^6\). Based on our estimation, it can be stated that social innovation formulated by Gershuny continues in Japan and the United States even after 1980. As a result, the almost constant composition ratios of durable goods and services contribute to the stability of \( \hat{\beta} \), which is the ratio of household machinery consumption and residential investment to the total disposable income.

Thus, \( \hat{y}_1 p_1 = \hat{y}_2 p_2 \), which shows that the amount of nominal expenditure of durable goods and that of services increase proportionally, and that these two composition ratios do not change. In fact, this elasticity is approximately one in our estimation using the data of Japan and the United States\(^7\). Based on our estimation, it can be

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6 Using the annual data of real consumption expenditure and the price index of ‘durable goods’ and 'services' in ARNA, \( \hat{y}_1 - \hat{y}_2 = -\eta(\hat{p}_1 - \hat{p}_2) \) is estimated. The estimated result for Japan from 1971–2003 is as follows: \( \eta = 0.96 \), t value = 5.77 and \( R^2 = 0.313 \). The result of a similar estimation for the U.S. from 1971–2003 using the annual data in NIPA is \( \eta = 0.83 \), t value = 3.46 and \( R^2 = 0.090 \).

7 Using the annual data of real consumption expenditure and the price index of ‘durable goods’ and 'services' in ARNA, \( \hat{y}_1 - \hat{y}_2 = -\eta(\hat{p}_1 - \hat{p}_2) \) is estimated. The estimated result for Japan from 1971–2003 is as follows: \( \eta = 0.96 \), t value = 5.77 and \( R^2 = 0.313 \). The result of a similar estimation for the U.S. from 1971–2003 using the annual data in NIPA is \( \eta = 0.83 \), t value = 3.46 and \( R^2 = 0.090 \).
stated that social innovation formulated by Gershuny continues in Japan and the United States even after 1980. As a result, the almost constant composition ratios of durable goods and services contribute to the stability of $\beta$, which is the ratio of household machinery consumption and residential investment to the total disposable income.

**Figure 3. The ratio of household machinery consumption and residential investment to the total disposable income ($\beta$)**

![Graph showing the ratio of household machinery consumption and residential investment to the total disposable income from 1929 to 2000 for the U.S. and Japan.]

3.3 Influence on the investment demand

Next, we examine the relationship between the change in the saving rate of profit income ($\hat{S}$) and the change in the prices of investment goods. The following investment functions were estimated with regard to Japan:

$$g_k = b_0 + b_1\theta + b_2r + b_3p_1$$  \hspace{1cm} (20)

The explained variable $g_k$ is the growth rate of non-residential fixed capital (the amount of nominal investment ($P^I$) divided by the amount of nominal stock ($K$)). The explanatory variables are $\theta$, the utilization rate in the manufacturing industry; $r = \Pi/K$, the profit rate in the corporate sector; and $p_1$, the price index of non-residential investment goods. The estimated result in the period from the first quarter of 1983 to the first quarter of 2002 is as follows, where the t values are presented in parentheses:

$$g_k = -0.229 + 0.264\theta + 0.105r + 0.101p_1 \quad R^2 = 0.842$$  \hspace{1cm} (21)

\hspace{1cm} (-7.99) (11.6) (1.67) (3.02)

---

8. The data source for the manufacturing utilization rates is OECD, Main Economic Indicators. The profit rate in the corporate sector is calculated from ARNA using the method mentioned in the appendix of Uni (Uni, 2000a). The price index of investment goods is obtained from ARNA. The following is the result of a similar estimation in the U.S. for 1991Q1–2001Q4 using the data in NIPA and Fixed Assets. The sign of the coefficient of the price is opposite to that in the case of Japan.

$$g_k = 0.387 + 0.178\theta + 0.289r - 0.409p_1 \quad R^2 = 0.931$$  \hspace{1cm} (15.0) (4.49) (3.91) (-17.2)

9. The first quarters of 1983 and 2002 are the troughs of the business cycle.
According to this result of the estimation, the level of the utilization rate has a considerably large influence on investment. The average utilization rate in the 1990s was approximately 7% lower than that in the 1980s; this alone depressed the capital accumulation rate by 2%. Excess capacity resulting from active investment during the period of the bubble economy led to the depression of investment. In addition, the coefficient of the prices of investment goods is positive. This implies that a price decrease in investment goods does not promote investment but depresses it. This is because in an enterprise with a high debt ratio, a price decline leads to a rise in the real value of its debt, and this serves as a brake on investment. In other words, the mechanism of debt deflation formulated by Fisher (1933) affected the Japanese economy in the 1990s (Boyer, 2004a). Moreover, there may exist the following causal relationships that Minsky (1982) formulated as the financial instability hypothesis. The demand price curve of investment goods shifts downward if enterprises, who are borrowers of investment funds, evaluate their risk as being higher. In a situation where the upward shift of the supply price curve of investment goods is suppressed by a zero-interest-rate policy, both the amount of investment and the prices of investment goods decrease with a downward shift of the demand price curve.

The following equation is derived from equation (20):

\[
\hat{g}_k = \left( \hat{p}_1 / K \right) = \left( \widehat{\pi}_1 / \Pi \right) + (\Pi / K) = \left( \widehat{\pi}_1 / \Pi \right) + \hat{r} \; ; \; B_1 \hat{\theta} + B_2 \hat{r} + B_3 \hat{p}_1 \tag{22}
\]

Here, \( B_1 = b_1 \hat{\theta} / \overline{g}_k \), \( B_2 = b_2 \hat{r} / \overline{g}_k \), \( B_3 = b_3 \hat{p}_1 / \overline{g}_k \).

By substituting equation (1) in equation (22), the following is obtained:

\[
\hat{r} = \left( \widehat{\pi}_1 / \Pi \right) = B_0 \hat{\theta} + (B_2 - 1) \hat{r} + B_3 [(\Gamma + m_1) + \hat{w} - \rho_1] = \hat{\delta}_0 - B_3 \rho_1 \tag{23}
\]

Here, \( \hat{\delta}_0 = B_0 \hat{\theta} + (B_2 - 1) \hat{r} + B_3 [(\Gamma + m_1) + \hat{w}] \).

By substituting equation (23) in equation (14), the following equation is derived:

\[
g_1 : z \hat{\delta} (\sigma - \tau B_3) \rho_1 + z \hat{\delta} \sigma \hat{L}_2 + z \hat{\delta} \tau \hat{\delta}_0 + z \hat{\delta} \tau \hat{\pi} - z \hat{\delta} \hat{\delta} \hat{\pi} + z (1 - \delta) \hat{E}_1 \tag{24}
\]

This is the demand regime function wherein the effect of deflation on investment has been taken into account. Its slope is smaller and its intercept is larger than equation (14). The difference depends on the contribution rate of the price of investment goods to the investment rate: \( B_3 = b_3 \hat{p}_1 / \overline{g}_k \). The actual value of this contribution rate, calculated from equation (21) as an average in the period of estimation, is 0.64. The slope decreases by 0.43, which is a product of this contribution rate and \( z \hat{\delta} \tau = 0.67 \).
Table 5. Estimated demand regime functions

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>$z\delta\sigma_1$ : Effect of the domestic distribution of productivity gains</td>
<td>0.71</td>
<td>0.72</td>
<td>0.86</td>
<td>0.83</td>
</tr>
<tr>
<td>$z\delta\sigma L_2$ : Effect of the employment increase</td>
<td>0.57%</td>
<td>0.51%</td>
<td>1.98%</td>
<td>1.58%</td>
</tr>
<tr>
<td>$z\delta\tau$ : Effect of the saving rate change</td>
<td>0.72%</td>
<td>−0.34%</td>
<td>−0.16%</td>
<td>0.14%</td>
</tr>
<tr>
<td>$z\delta\pi$ : Effect of the profit share change</td>
<td>−0.07%</td>
<td>−0.81%</td>
<td>%</td>
<td>0.14%</td>
</tr>
<tr>
<td>$−z\delta\alpha$ : Effect of the sectoral differential of the mark-up change</td>
<td>0.07%</td>
<td>0.43%</td>
<td>−1.03%</td>
<td>0.17%</td>
</tr>
<tr>
<td>$z(1−\delta)\hat{E}$ \textsubscript{1} : Effect of the export demand change</td>
<td>1.51%</td>
<td>1.08%</td>
<td>0.67%</td>
<td>1.36%</td>
</tr>
<tr>
<td>Demand regime function</td>
<td>$0.71\rho_1$ + $0.72\rho_1 + 0.86\rho_1 +$</td>
<td>2.80</td>
<td>0.83\rho_1 + 3.05</td>
<td></td>
</tr>
<tr>
<td>Demand regime function containing the deflation effect</td>
<td>$0.29\rho_1 + 1.73$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(\delta, \sigma, \tau, L_2\) are calculated from the input-output tables cited below. \(\Delta\) is calculated from the growth rates of price and labour productivity shown in Table 2. \(s, \pi, E_1\) are calculated from ARN.4 and NIP.4. For \(s, \pi\), the data of the corporate sector is used. After removing their cyclical fluctuations using the five-year moving average, their growth rates \(s, \pi, E_1\) are calculated.


Table 5 shows the estimated demand regime functions. In Japan, the first half of the 1980s was a period of export-led growth (Uni, 1998), indicated in this table by the comparatively large ‘effect of the export demand change’. However, this effect reduced in the 1990s because of the establishment of the adjustment pattern of exchange rates mentioned in section 3.1. Moreover, the latter half of the 1980s was marked by the bubble economy and enterprises invested vigorously, indicated by the positive ‘effect of the saving rate change’. Further, this effect became negative in the 1990s after the bursting of the bubble economy. Since the elasticity of employment and wages remained low even under the recession in the 1990s, profits were squeezed and the profit share declined; this is indicated by the negative ‘effect of the profit share change’. These negative effects of the saving rate change and the profit share change led to a major slowdown in investment. Due to these factors, the value of the intercept of the demand regime function in the 1990s is smaller than that in the 1980s. Moreover, the column ‘Japan 1990–2000’ in Table 5 also shows the estimated demand regime function containing the deflation effect. This function has a smaller slope and a larger intercept than the demand regime function that does not contain the deflation effect. Figures 4 and 5 show the estimated demand regime functions on a plane, whose horizontal axis is the growth rate of demand and whose
vertical axis is the growth rate of labour productivity. Figure 4 indicates that in Japan, the demand regime shifted leftward to a great extent.

With regard to the demand regime function in the United States, the slope changed negligibly, but the intercept became larger in the period from 1987–1997 than in the period from 1977–1987, as shown in Table 5. The reasons for this increase of the intercept include an increase in the effect of the export demand change, a reduction in the sectoral differential of the mark-up change, etc. Although the mark-up rate in the investment goods sector tended to rise in the period from 1977–1987, this tendency disappeared in the period from 1987–1997 as a result of the intensified competition between enterprises. The reduction of the sectoral differential of the mark-up change promoted a decrease in the relative prices of investment goods according to the productivity gap, as shown in equation (10). This led to an increase in the real demand for investment goods. In addition, this increase was supported by the upturn of the saving rate of the profit income. Consequently, the intercept of the demand regime function in the United States increased and the demand regime shifted rightward, as shown in Figure 5.

4. Estimation of productivity regimes

As mentioned in section 2.3, the productivity regime is influenced by technical factors such as the labour saving effect of qualitative changes in production equipment and institutional factors such as institutions concerned with employment protection. Although these factors vary by enterprise or industry, the individual productivity regime in each enterprise or industry is not greatly affected by the business cycle. Therefore, productivity regimes have short-term stability to a large extent. On the other hand, demand regimes are accompanied by short-term fluctuations because the cyclical changes in investment demand are especially large. While the demand regimes indicated in Table 5 and in Figures 4 and 5 are their average positions in the period of estimation, the actual demand regimes fluctuate cyclically around these average positions. If we assume short-term stability of productivity regimes and short-term fluctuation of demand regimes, then the productivity regime function is shown by the regression line obtained by a regression analysis using the time series data of the growth rate of labour productivity as an explained variable and the growth rate of demand as an explanatory variable.

The dynamics in the investment goods sector are important because the changes in this sector are closely related to the changes in the macroeconomic performance of Japan and the United States, as mentioned in section 1. In the 1990s, when the IT revolution progressed, the investment in IT-related machinery—such as the industrial use robot, the NC machine tool, CAD/CAM, the optical communication systems and computers—played a definite role in the labour productivity growth.

Investment goods comprise building and machinery equipment. Since the productivity growth in construction was low in both countries in the 1990s, its role in the cumulative causation was small. Therefore, in our estimation of productivity regimes, we focus on the machinery manufacturing sector. The estimated productivity regime functions are shown in Table 6.
Table 6. Estimated productivity regime functions

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Constants</td>
<td>0.014</td>
<td>0.016</td>
<td>0.020</td>
<td>0.016</td>
</tr>
<tr>
<td>(1.46)</td>
<td>(3.37)</td>
<td>(2.87)</td>
<td>(3.00)</td>
<td></td>
</tr>
<tr>
<td>Coefficients of the growth rate of demand</td>
<td>0.660</td>
<td>0.875</td>
<td>0.444</td>
<td>0.753</td>
</tr>
<tr>
<td>$\beta$</td>
<td>(7.54)</td>
<td>(13.7)</td>
<td>(7.29)</td>
<td>(15.9)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.550</td>
<td>0.831</td>
<td>0.655</td>
<td>0.864</td>
</tr>
</tbody>
</table>

The estimated variables are the growth rate of labour productivity. Peak-to-peak periods are selected. The pooled annual data of the real GDP and the number of employed persons in the following three sectors are used. The values in parentheses are the t values.

Sources: Japan: ARNA, ‘Machinery’, ‘Electrical machinery, equipment and supplies’ and ‘Transport equipment’.


In both these countries, the coefficients of the growth rate of demand are larger in the 1990s than in the 1980s. This implies that the elasticity of employment reduced in the 1990s because this coefficient is equal to $\beta - 1$ – the elasticity of employment). The low elasticity of employment in the recession period in Japan suggests that the reduction of employment was slow and on a small scale (Ministry of Labour, 2002, Table 3–7, Boyer and Juillard, 2000). Further, the low elasticity of employment in Japan in comparison with other advanced countries was maintained even in the 1990s (Uni, 2000b). This is probably the result of the inertia of the employment system.

Moreover, in the United States, the elasticity of employment in the machinery sector decreased considerably, from 0.56 in 1978–1987 to 0.25 in 1988–2001. However, this situation differs from Japan in the following way. The low elasticity of employment in the boom period in the United States suggests that the increase of employment was slow and on a small scale. We assume that this is the result of the ‘downsizing boom’ or the ‘restructuring boom’ that began in the latter half of the 1980s (Osterman, 1999). As a result, U.S. enterprises aimed to concentrate on core competence and advanced outsourcing (disposal of non-core businesses). Moreover, they employed IT technology, thereby reducing the number of middle-ranking managerial posts and white-collar workers. In addition, they introduced Japanese techniques such as team production, quality control circles and job rotations.

Based on the average of the samples in the above regression analysis, the growth rate of output from 1978–1987 is 3.8% and that from 1988–2001 is 7.0%. If the elasticity of employment stayed constant at 0.56, this output growth would bring about a 1.7% growth in employment. However, the actual growth rate of employment was 0% because the elasticity of employment had decreased to 0.25 as a result of the above-mentioned organizational and managerial innovations in U.S. enterprises. Thus, the increase in the slope of the productivity regime function, as shown in Figure 5, was caused by the suppression of employment growth during the boom.

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10 However, after 1998, the substitution of non-regular workers for regular workers became prevalent in Japan. The ratio of part-time workers in the total employment increased from 16.3% in 1997 to 19.5% in 1998 and reached 23.7% in 2004.
Conclusions

As indicated in Figure 5, the demand regime in the United States shifted rightward from 1977–1987 to 1987–1997, and the slope of the productivity regime increased. These changes led to an increase in both the growth rate of demand and that of productivity, as shown by the intersection of these two regimes in Figure 5. Based on the model of Baumol (1967), such a relatively high growth of demand in a sector with a relatively high growth of productivity sustains macroeconomic growth. As shown in Figure 4, the demand regime in Japan shifted leftward from the 1980s to the 1990s, while the slope of the productivity regime increased. Consequently, the growth rate of demand was reduced in the 1990s. Hence, based on Baumol’s model, such a relatively low growth of demand in a sector with a relatively high growth of productivity leads to a decrease in the macroeconomic growth rate.

The causes of these changes in the growth regimes in Japan and the United States are summarized as follows. In the 1990s, the influence of the technological progress in the IT field resulted in labour productivity growth in the machinery manufacturing sector. Although this machinery-biased productivity growth occurred in Japan as well, it was more remarkable in the United States. This resulted in an increase in the slope of the productivity regimes in these two countries. In addition, the organizational and managerial innovations of U.S. enterprises that commenced in the latter half of the 1980s contributed to the increase in the slope of the productivity regime. As a result of the high growth in investment and export demands in the 1990s, the demand regime shifted rightward in the United States. Conversely, in Japan, during the same period, the demand regime shifted leftward because of the slowdown in the export demand and the stagnation of investment demand. Although overcapacity created during the period of the bubble economy is the main cause of the stagnation of investment demand, the price decrease in investment goods is also related to this stagnation.

Bibliographie


