The Finance-led Growth Regime in the United States: a Fundamental Dilemma in Cumulative Causation

Hiroyuki Uni

Graduate School of Economics, Kyoto University, Kyoto 606-8501, Japan
Tel.: +81 75 753 3444, Fax: +81 75 753 3492
E-mail address: uni@econ.kyoto-u.ac.jp

Abstract

Recent theoretical and empirical analyses have further developed Kaldor’s concept of ‘cumulative causation’. They formalise two-way routes between labour productivity growth and demand growth: the ‘demand regime’ and ‘productivity regime’. In this paper, to analyse the growth regime in the United States since the 1990s, we formulate the demand regime by explicitly taking into account capital accumulation. Using a cumulative causation model with two sectors that produce consumer goods and investment goods respectively, we examine the structure of the finance-led growth regime and the causes of the structural crisis in the United States. According to our analysis, huge foreign capital inflows, financial innovation, strong-dollar policies, and the like have substantially increased the sensitivity of asset prices in the real economy, and they did not bring about a virtuous cycle therein. In the 2000s, the demand regime of investment goods shifted leftwards, compared to its position of in the 1990s. The slowdown in real economic growth caused a sharp fall in asset prices when they were strongly sensitive to the real economy. Thus, the structural crisis emerged.
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1. Introduction

The causes of the current global financial crisis are rooted both in the financial side and real side of the economy. Shadow-banking, the securitisation of loan assets, financial deregulation, excessive foreign capital inflows, and subprime lending have been the causes on the financial side, while the weakening of the manufacturing sector, expanding current account deficits, and the excessive housing boom have been the causes on the real side. These two types of causes are closely related, because an expansion in current account deficits implies an increase in international capital inflows, a portion of which flowed into the United States in the form of foreigners’ purchases of securitised housing loans. However, there are various opinions about the ultimate cause of the current global financial crisis. For instance, on the one hand, the ‘global saving glut’ hypothesis shifts blame for the massive current account deficit in the United States onto East Asian countries (Rajan 2020, p. 82), while on the other hand, Roubini and Mihm (2010) remark that the ultimate responsibility rested with the United States and China’s excessive saving was a factor that enabled the United States to expand its current account deficit (p. 250)1. Furthermore, on the one hand, Rajan (2010) mentions that successive governments pushed Fannie Mae and Freddie Mac to support low-income lending and that this contributed significantly to the crisis, while on the other hand, Stiglitz (2010), Roubini and Mihm (2010), and the Financial Crisis Inquiry Commission (2011) each judge the roles of the government and these government-sponsored enterprises to be minor, and that the financial sector should bear the major onus of blame.

Thus, the mainstream tends to emphasise the government failure, and Keynesianism tends to emphasise the market failure. In contrast to both, in this paper, we explain that the cause of the crisis is rooted in the structure of the finance-led growth regime, and that this crisis is a ‘structural crisis’ in terms of Régulation Theory. We theoretically and empirically analyse the growth regime in the United States in the 1990s and clarify that a fundamental dilemma was inherent in its dynamic structure.

The rest of this paper is organised as follows. In Section 2, we explain the analytical framework. In Section 3, we outline the real economy in the United States since the 1990s. In Section 4, we estimate the ‘productivity regime’, which is the route from demand growth to

1 The Financial Crisis Inquiry Commission (2011) mentions that capital inflows would not necessarily have caused a crisis, and that the principal cause was the failure to effectively rein in excesses in the mortgage and financial markets (p. xxxvi).
labour productivity growth: in particular, we clarify how institutional causes for soaring asset prices affected the productivity regime. In Section 5, we formulate the ‘demand regime’, which is the route from labour productivity growth to demand growth. In Section 6, we estimate the demand regime and clarify how the institutional causes of soaring asset prices affected the demand regime. Our conclusions regarding the dilemma in the finance-led growth regime in the United States are summarised in Section 7.

2. The analytical framework

The growth regime in the United States since 1990 has often been analysed as a ‘finance-led growth regime’. The following chain of causation relating to both the financial side and the real side of the economy sustains the finance-led growth regime (Boyer 2000):

Increase in stock market price $\rightarrow$ Easy access to credit $\rightarrow$ Increase in consumption and investment $\rightarrow$ Increase in production $\rightarrow$ Increase in profit $\rightarrow$ Increase in dividends and pension funds $\rightarrow$ Increase in stock market price. We measured correlation between the growth rate of stock prices and that of the real GDP. Although this correlation was very weak from 1980 to 1994, as shown in Figure 1, there was a clear and positive correlation from 1995 to 2009, as shown in Figure 2. The slope of the regression line is very steep: when the real GDP grows by 1 percent, stock prices grow by 6.37 percent. This means that since 1995, stock prices have become strongly sensitive to the real economy. Also, the relationship between the growth rate of housing prices and the economic growth rate is shown in Figures 3 and 4. The slope of the regression line increased from 2.34 to 4.31; this means that since 2000, housing prices have also become strongly sensitive to the real economy.

Figure 5 shows the basic analytical framework of this paper. The straight line labelled ‘asset price regime’ represents the relationship between economic growth and asset price inflation, as shown in Figures 1–4. As mentioned, the slope of the asset price regime is quite large in a finance-led growth regime. Increases in foreign capital inflows, financial innovations such as the securitisation of loan assets, strong-dollar policies, and the like contributed to an increase in this slope. Two straight lines labelled ‘demand regime’ and ‘productivity regimes’ are also shown in Figure 5. Demand regime represents a causal linkage from labour productivity growth to demand growth, and the productivity regimes represent a reverse causal linkage. As will be mentioned later, changes in income distribution and expenditure structure affect the position of the demand regime. The slope of the productivity regime represents the strength of dynamic increasing returns, as first studied by Verdoon and Kaldor. Its position is affected by various institutions related to innovation. Demand regimes and productivity regimes constitute cumulative causation in the real economy, and the intersection of these two determines the economic growth rate (Kaldor 1966, 1970; Boyer
This cumulative causation on the real side of the economy affects the financial side. The asset price regime represents this dynamic effect on asset prices, and the strength of this effect is indicated by the position of this regime.

As we explain in detail in this paper, the dynamic structure of the finance-led growth regime in the United States contains the following fundamental dilemma. With an increase in foreign capital inflows, financial innovations such as the securitisation of loan assets, the strong-dollar policies, and the like contributed to a steepening of the asset price regime, while they had negative effects on the cumulative causation on the real side of the economy. Since they contributed to a leftward shift in the demand regime, the economic growth rate decreased. This slowdown in real economic growth caused a sharp fall in asset prices, under the very steep asset price regime shown in Figures 2 and 4. Thus, since 2007, asset prices declined, simultaneous with a contraction of the real economy. A brief description of the proposition is as follows. Institutional factors affect the positions of three regimes that comprise a dynamic economy structure. Although institutional changes in the United States had positive effects on the position of the asset price regime, they had negative effects on the demand regime.

The viewpoint of Brenner (2009) is similar to ours. Brenner mentions that the fundamental source of today’s crisis is the steadily declining vitality of advanced capitalist economies over three decades. This long-term weakening of capital accumulation and of aggregate demand has been rooted in a profound system-wide decline and a failure to recover the rate of return on capital, resulting largely from a persistent overcapacity tendency among global manufacturing industries (Ibid., p. 2). He explains the chronology of events in the world economy, focusing on the United States between 1973 and 2007. Although the rate of return among manufacturing industries in the United States had decreased since the 1970s, it recovered on account of the Plaza Accord in 1985, to the mid-1990s. The reason for this recovery was that the combination of industrial shakeout, wage repression, and dollar devaluation detonated a fundamental shift in the modus operandi of US manufacturing toward an increasing reliance upon exports (Brenner 2002, p. 64). However, the dollar devaluation brought about an impasse among manufacturing industries in Japan and Germany. Triggered by the Reverse Plaza Accord in 1995, the United States moved from traditional Keynesianism to ‘asset price Keynesianism’ (Brenner 2009, p. 2). Corporations and households, rather than the government, propel the economy forward, through titanic bouts of borrowing and deficit spending—both of which were made possible by historic increases in their on-paper wealth, themselves enabled by record run-ups in asset prices, with the latter animated by low borrowing costs. The key to the whole process is an unceasing supply of cheap credit to fuel asset markets, which are ultimately insured by the Federal Reserve Board (FRB). East Asian governments supported the supply of cheap credit by making endless purchases of dollar-denominated assets, with the goals of keeping the value of their
currencies down and the competitiveness of their manufacturing up.

According to Brenner, there were two rounds of asset price Keynesianism. In the first round, between 1995 and 2000, waves of speculation concentrated in equities. In the second round, between 2000 and 2007, waves of speculation concentrated in housing and leveraged lending (Ibid., p. 3). Brenner mentions that neither round of asset price Keynesianism made any impression on underlying trends toward system-wide economic enfeeblement. He explains the reason, in descriptive terms, as follows. With regard to asset price, Keynesianism that focuses on equities—first, in the investment boom related to information technology, and then in the stock market bubble—engendered not only massive overinvestment but a stunning misdirection of capital among industry lines (Ibid., p. 30). Second, the US manufacturing trade deficit increased because of its overvalued dollar (Ibid., p. 30), and US manufacturing industries were forced to drive down prices in order to compete with those of East Asian countries (Ibid., p. 32). Thus, asset price Keynesianism that focuses on equities brought about a decline in profitability.

Asset price Keynesianism that focuses on housing also brought about a decline in profitability, for the following reasons. Confronting the overcapacity of the first round, corporations needed to hold down investment (Ibid., p. 63). Although they tried to recover profitability by implementing layoffs, speeding up production, and suppressing wages, in the absence of investment, productivity growth was restricted (Ibid., p. 67) and so was profit growth. The second reason for the decline in the first round, that is, a decline in competitiveness due to an overvalued dollar, was also at work in the second round.

In this paper, we analyse Brenner’s aforementioned propositions, using an economic growth model based on the idea of cumulative causation. We discuss, more explicitly, the proposition that asset price Keynesianism brings about a slowing-down in the real economy. Brenner connects this proposition with the long-term tendency of profit rates to fall, which has been based on worldwide manufacturing overcapacity and excess-supply trends in developed capitalist economies. However, we do not adopt the law of falling profit rates, because the route to the financial crisis in the United States was quite different from that explained by this law, as will be shown later.
Figure 1. Correlation between the stock price growth and the real economic growth (1980–94)

\[ y = 1.3952x + 0.0756 \]

(1.77) (2.59)

\[ R^2 = 0.0512 \]

Sources: x-axis: The growth rate of real GDP (year-on-year rate of increase of quarterly data), BEA, NIPA. y-axis: The growth rate of Dow Jones Industrial Average (year-on-year rate of increase of quarterly data). Each number in parentheses is a t value.

Figure 2. Correlation between the stock price growth and the real economic growth (1995–2009)

\[ y = 6.3746x - 0.0898 \]

(9.17) (-3.95)

\[ R^2 = 0.5920 \]

Sources: See Figure 1.
Figure 3. Correlation between the housing price growth and the real economic growth (1988–99)

\[ y = 2.3431x - 0.046 \]
\[ (6.23) \quad (-3.40) \]
\[ R^2 = 0.4576 \]

Sources: x-axis: The growth rate of real GDP (year-on-year rate of increase of quarterly data), BEA, NIPA. y-axis: The growth rate of S&P/Case-Shiller Home Price Indices (year-on-year rate of increase of quarterly data of Composite-10). Each number in parentheses is a \( t \) value.

Figure 4. Correlation between the housing price growth and the real economic growth (2000–09)

\[ y = 4.3123x - 0.0204 \]
\[ (6.75) \quad (-1.15) \]
\[ R^2 = 0.5455 \]

Sources: See Figure 3.
Figure 5. Demand Regime, Productivity Regime and Asset Price Regime

3. The real economy in the United States since the 1990s

The US economy continued to grow by 3% annually in the 1990s, led by the high growth of private business capital investment. The background is as follows. Personal computers, the Internet, and mobile phones diffused, and the so-called ‘information technology (IT) boom’ occurred at the end of the 1990s. IT related investment rose sharply, and the stock prices of IT related companies shot up. However, the market for personal computers and mobile phones was saturated at the end of the 1990s. The stock of these products accumulated, and semiconductor demand declined. As a result, the price of semiconductors fell sharply, the profit of the semiconductor manufacturers declined, and their investment decreased. This affected the stock market and the stock price of IT related companies fell sharply in 2001. It was the collapse of the IT bubble. In addition, the series of terrorist attacks in September 2001 definitely slowed down consumption and investment and made the recession in 2001 serious.

FRB reduced the federal funds rate to the 1% level and continued the low interest policy until 2004. This became the inducement for the housing bubble. Moreover, the deregulation with the abolition of Glass-Steagall Act and the development of securitisation technology progressed simultaneously. As a result, it became possible for the securities firms to manage
housing loan companies and securitise financed housing loans. They built in such securitised housing loan papers for persons with low creditworthiness, which were called sub-prime loan. In addition, they rearranged these loans to the financial derivative and dealt with them through their subsidiary fund and investment vehicles that the financial regulatory authority could not supervise. Since such a securitised paper was very complex, investors and financial institutions undervalued its risk. Moreover, the financial supervisory system that played a role in monitoring management soundness of financial institutions was incomplete. House prices declined sharply after peaking in 2006. This led to defaults on sub-prime loans. The failure of housing loan companies started in 2007. The crisis of major securities companies and banks occurred in 2008 and was called a Lehman shock. The financial crisis in the United States spread to almost all countries in the world because these securitised papers were sold abroad. All of this contributed to the foreign capital inflow to the United States.

The macroeconomic situation mentioned above is associated with the two-sector dynamics of the real economy shown in Table 1. The growth rate of labour productivity in the residential investment sector exceeds that in the consumption sector and the residential investment sector. The non-residential 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 demand growth rates differ greatly by sector and period. The growth rate of the demand for non-residential investment was high during the 1987–97 period. However, that for residential investment was high from 1998–2005. Thus, both the labour productivity growth rate and the demand growth rate are high and the virtuous cycle was established in the 1987–97 period in the investment sector, especially in the non-residential investment sector. However, the demand growth slowed down from 1998 to 2005.

The growth rate of the nominal wage is close to the labour productivity growth rate in the non-residential investment sector. As a result, there was a slight change in the prices of non-residential investment goods, the productivity of which grew at similar rate to the wage. However, there was an increase in the prices of consumer goods, the productivity of which grew more slowly than the wage. The price index of all goods rose and a gradual inflation occurred in the entire economy. The general price index in which both are synthesised rises, and a gradual inflation is seen as the entire economy.
Table 1. Sectoral Dynamics (annual growth rate, unit: %)

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<tbody>
<tr>
<td><strong>Labour productivity</strong></td>
<td>2.5→2.7</td>
<td>3.4→5.1</td>
<td>1.0→0.1</td>
<td>1.2→2.0</td>
</tr>
<tr>
<td><strong>Real final demand</strong></td>
<td>4.5→3.3</td>
<td>5.2→2.4</td>
<td>1.3→5.2</td>
<td>2.5→3.3</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>1.1→1.8</td>
<td>0.5→0.3</td>
<td>2.7→4.9</td>
<td>2.9→2.5</td>
</tr>
<tr>
<td><strong>Nominal wage rate</strong></td>
<td>3.7→3.5</td>
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Note 1: 1987, 1997, and 2005 are about 2–3 years before official peaks of the business cycle. Therefore, the above periodisation slightly entails the bias by the business cycle. Moreover, the category of ‘Non-residential investment + Residential investment’ overlaps with ‘investment goods’ in this paper and ‘Private consumption + Government expenditure’ overlaps with ‘consumption goods’.

Note 2: The growth rates of the labour productivity in each sector 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.


Moreover, an increase in foreign capital inflow is important as a background of finance-led growth regime. In the United States, triggered by the Reverse Plaza Accord in 1995, the current accounts deficit and the foreign capital inflow increased rapidly.

Figure 6 shows the amount of net external fund borrowing by sector. As shown in this figure, the household sector remained in surplus until 1998 and ran a deficit from 1999 because of an increase in the housing loans. The net external fund borrowing of the private business sector has been nearly zero in most years but it was positive from 1997 to 2001 and 2006 to 2008. A surplus in the former period reflects the active capital investment in the IT boom. The government sector had a consistent deficit except for in the 1998–2000 period and the government deficit expanded rapidly after the financial crisis in 2008. The ‘external fund dependence rate’ of the private business sector (\( \delta_p \)) and that of the household and government sector (\( \delta_c \)) are shown in Figure 7. This external fund is foreign capital because both rates were positive in most years. The foreign capital flowed chiefly into the government sector until 1996 and into the private business sector in the 1997–2001 period. It has been flowing into the household and the government since 2002.
Figure 6. Net Borrowing by Sector (Unit: billion dollars)

Note: For instance, in the case of the private business sector, Net borrowing = Investment (Table F101-Line 4) – Saving (Table F101-Line 2).

Figure 7. External Fund Dependence Rate by Sector

Note: For instance, in the case of the private business sector, External fund dependence rate ($\delta_i$) = Net borrowing / (Investment (Table F101-Line 4) – Net borrowing).
4. Effects of institutional causes for soaring asset prices on productivity regime

The productivity regime is an equation formulating the route from demand growth to labour productivity growth. It is mediated by an adjustment of production equipment and employment. Productivity growth is influenced chiefly by technical factors such as the labour saving effect of qualitative changes in production equipment and institutional factors such as institutions becoming concerned with employment protection. Although these factors vary by enterprise or industry, they are not greatly affected by the business cycle. Therefore, the productivity regime has short-term stability to a large extent. On the other hand, the demand regime is accompanied by short-term fluctuations because the cyclical changes in investment demand are especially large. 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.

However, the following two-stage procedure is necessary for estimation of the productivity regime function of investment goods. Investment goods chiefly consist of buildings and structures, machinery, and equipment. With regard to buildings and structures, both demand growth rate and labour productivity growth rate are quite low and nearly zero in most years from 1988 to 2005. In this case, a significant estimated value is not obtained by the least squares method. In the first stage, we estimate the productivity regime function using only the data of machinery and equipment based on the equation (3) in Appendix 1. Next, in the second stage, using this result, we calculate the estimated value including buildings and structures based on the equation (4) in Appendix 1. The result is shown in Table 2.

Table 2. Result of Estimation of Productivity Regime Function

<table>
<thead>
<tr>
<th></th>
<th>Investment goods</th>
<th>Consumption goods</th>
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<tbody>
<tr>
<td>Coefficients</td>
<td></td>
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<tr>
<td>(Size of slope: $a_M$)</td>
<td>0.690 (11.1) 0.694 (10.7)</td>
<td>0.437 (5.33) 0.791 (9.25)</td>
</tr>
<tr>
<td>Constants</td>
<td></td>
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<tr>
<td>(Size of intercept: $b_M$, Unit: %)</td>
<td>2.16 (3.11) 3.14 (4.83)</td>
<td>-0.12 (-0.42) -0.64 (-2.13)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.782 0.617</td>
<td>0.009 0.392</td>
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Constants
Including construction sector

$ab_M + (1 - \alpha) \bar{\rho}_C - a_M (1 - \alpha) \bar{g}_C$

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<tr>
<td>0.73</td>
<td>1.50</td>
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Note: An explanatory variable is the growth rate of real output by industry and an explained variable is the growth rate of labour productivity by industry (labour productivity = real output / number of persons engaged in production). The values in parentheses are the t values. The method of regression analysis is weighted least squares using the number of persons engaged in production as a weight.

Source: We calculated from ‘Chain-type quantity indexes for gross output table’ and ‘Persons engaged in
production table’ in BEA, *GDP by Industry*, which is based on 1987SIC from 1988 to 1998 and NAICS from 1999 to 2007. With regard to investment goods from 1999 to 2007, the pooled annual data in the following six industries are used. ‘Machinery’, ‘Computer and electronic products’, ‘Electrical equipment, appliances, and components’, ‘Motor vehicles, bodies and trailers, and parts’, ‘Other transportation equipment’, and ‘Computer systems design and related services’. With regard to consumption goods, the pooled annual data in the following seven industries are used. They are the largest seven industries in the amount of final demand in *the U.S. Input-Output Tables* in 2005. ‘State and local government and enterprises’, ‘Retail trade’, ‘Federal government and enterprises’, ‘Hospitals and nursing and residential care facilities’, ‘Ambulatory health care services’, ‘Other services, except government’, and ‘Food and beverage and tobacco products’. Although ‘Real estate’ has the largest final demand, we exclude it because it contains the imputed rent. Moreover, we exclude ‘Wholesale trade’ and ‘Food services and drinking places’ because there are some outliers in the data. With regard to investment goods from 1988 to 1998, we use the data in ‘Industrial machinery and equipment’, ‘Electronic and other electric equipment’ and ‘Motor vehicles and equipment’. With regard to consumption goods from 1988 to 1998, we use the data in the following six industries. ‘State and local government and enterprises’, ‘Retail trade’, ‘Federal government and enterprises’, ‘Health services’, ‘Other services’, and ‘Food and kindred products’.

**Figure 8. Growth Regime in the United States (Investment goods sector)**

<table>
<thead>
<tr>
<th>Productivity growth rate ($\rho_1$)</th>
<th>Demand regime (2005) $g_1 = 0.7% + 0.51 \rho_1$</th>
<th>Demand regime (1998) $g_1 = 1.6% + 0.51 \rho_1$</th>
<th>Productivity regime (1999–2005) $\rho_1 = 1.5% + 0.69 g_1$</th>
<th>Productivity regime (1988–98) $\rho_1 = 0.73% + 0.69 g_1$</th>
</tr>
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<tbody>
<tr>
<td>0.73</td>
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<tr>
<td>1.5</td>
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<tr>
<td>1.6</td>
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<td>0</td>
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Based on the result of estimation of productivity regime shown in Table 2, Figure 8 shows the position of the productivity regime of investment goods. It shifted upwards in the 2000s as compared with the 1990s. Although the slope does not change, the intercept in the 2000s is a little larger than that in the 1990s. The amount of labour saved by the introduction of new equipment might increase and cancel out the negative effect of the asset price Keynesianism that focuses on housing. Moreover, according to the result with regard to consumption goods, the effect of dynamic increasing returns action was not clear because both the estimated coefficient ($a_M$) and the coefficient of determination ($R^2$) were small in the 1990s. However, the slope and the coefficient of determination in the 2000s became large. Thus, the dynamic increasing returns became clear also with regard to consumption goods in the 2000s.
Consumption goods consist of not only manufacturing products but also various services. The spread of the personal computer and the Internet in service production might increase the effect of dynamic increasing returns. However, the intercept of the productivity regime function of consumption goods is smaller than that of investment goods even in the 2000s.

With regard to machinery manufacturing sector, such increase in the slope of productivity regime occurred in the end of the 1980s. The size of the slope \(a_{m}^{}\) in 1978–87 was 0.331. As the slope of productivity regime equals 1 minus the elasticity of employment, this increase in the slope means that the elasticity of employment in the machinery manufacturing sector decreased considerably. As mentioned in Uni (2007), the reason for this is as follows. The increase of employment in the boom period in the 1990s was slow and on a small scale. 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.

5. Demand regime and its three components

Dixon and Thirlwall (1975) and Boyer (1988) are well-known as theoretical and empirical analyses based on Kaldor’s concept of ‘cumulative causation’ in the relationship between productivity growth and demand growth (Kaldor 1966, 1970). Recently, Naastepad (2006), Rada and Taylor (2006), Taylor and Rada (2007), Uni (2007), Ocampo et al. (2009) and Fujita (2009) have developed along this line. However, these studies are insufficient in terms of formulating demand regime, which is the route from labour productivity growth and demand growth. Their limitation is that capital accumulation is abstracted. Since the demand regime shows the middle- and long-term relationship between labour productivity growth and demand growth, it is necessary to incorporate capital accumulation, which is one of the factors of long-term economic growth as well as technological change.

In Appendix 2, for analysis of the growth regime in the United States in the 2000s, we formulate the demand regime by explicitly taking capital accumulation into account. Using a cumulative causation model with two sectors producing consumer goods and investment goods respectively, we examine how three structural changes affect cumulative causation. The first is remarkable labour productivity growth in IT-related industries owing to rapid technological progress and non-residential investment boom. This relates to the asset price Keynesianism that focuses on equities. The second is housing boom, which relates to the asset price Keynesianism that focuses on housing. The third is an increase in trade deficit and
capital inflow.

Briefly speaking, the demand regime function shows a constraint at the macroeconomic level between demand growth and labour productivity growth. The Cambridge equation \((g = sr)\) is well known as a dynamic constraint at the macroeconomic level. 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.

Equation (15) in Appendix 2 can be understood as the demand regime function of investment goods that shows the relation between labour productivity and demand growth. The first term \((sr(1 + \delta_s))\) in the right-hand side of equation (15) corresponds to the Cambridge equation and represents the effect of the capital accumulation. As previously mentioned, \(\delta_s \geq -1\). Therefore, this ‘capital accumulation effect’ is always nonnegative. The larger the external fund dependence rate of the private business sector \((\delta_s)\), the larger this effect is. On the other hand, the external fund dependence rate of the household and government sector \((\delta_c)\) is irrelevant to the capital accumulation effect.

The second term \((\eta_m(\rho_1 - \rho_2))\) in the right-hand side of equation (15) is proportional to the growth rate of the relative price\(^2\) and represents the effect of the relative price change. As mentioned in Appendix 2, \(0 < \eta_m < 1\). Therefore, this effect is positive when the labour productivity growth rate of investment goods \((\rho_1)\) is larger than that of consumption goods \((\rho_2)\).

The third term \((\eta_h + 1)\hat{k}\) represents the effect of the demand structure change. As mentioned in Appendix 2, \(\eta_h > -1\). Therefore, this ‘demand structure change effect’ is positive when the demand structure parameter \((k)\) increases. However, it is negative when \(k\) decreases.

We plot this function on a plane where the horizontal axis shows the growth rate of demand and the vertical axis shows the growth rate of labour productivity. As shown in Figure 9, this demand regime function is an upward-sloping straight line, which passes through a point \((\rho_2, sr(1 + \delta_s) + (\eta_h + 1)\hat{k})\) and the slope of which is \(1/\eta_m\).

Equation (16) in Appendix 2 can be understood as the demand regime function of consumption goods. It is also the sum of capital accumulation effect, relative price change effect, and demand structure change effect. As mentioned in Appendix 2, the relative price change effect and the demand structure change effect with regard to consumption goods are

\[\hat{p} = -(1 + \psi)\eta_m(\rho_1 - \rho_2),\] where \(\psi = r/(1/h - r) > 0\).
quite small compared with that for investment goods. If we draw the demand regime function of consumption goods on a plane similar to that in Figure 9, it is a steep upward-sloping straight line, the slope of which is nearly vertical.

Figure 9. Demand Regime and Productivity Regime

Labour productivity growth rate

Demand regime of the investment goods

Productivity regime of the investment goods

Productivity regime of the consumption goods

Demand regime of the consumption goods

Demand growth rate

Capital accumulation effect

Demand structure change effect

Relative price change effect

Note: Although it is better to draw regimes of the consumption goods in another plane, we superimpose it on the plane of the investment goods.

6. Effects of institutional causes for soaring asset prices on demand regime

The productivity regimes with regard to investment goods and consumption goods are shown as follows.

\[ \rho_1 = a_1 g_1 + b_1 \quad (0 < a_1 < 1, b_1 > 0) \quad (17) \]

\[ \rho_2 = a_2 g_2 + b_2 \quad (0 < a_2 < 1, b_2 > 0) \quad (18) \]

Two demand regime functions shown by equation (15) and (16) and two productivity regime functions shown by equations (17) and (18) determine the demand growth rate of each
goods \((g_1, g_2)\) and the labour productivity growth rate \((\rho_1, \rho_2)\). However, the explicit solution of these four simultaneous equations is complex and its economic meaning is difficult to understand intuitively. Therefore, using Figure 9, we explain the approximate solution obtained by assuming that the demand regime function of consumption goods is a vertical straight line, that is \(g_2 = sr(1 + \delta_t)\).

In Figure 9, this vertical line intersects with the productivity regime function of consumption goods. The height of this intersection \((P_1)\) shows the labour productivity growth rate of the consumption goods \((\rho_1)\).

The demand regime function of investment goods passes through a point \(Q_1 (\rho_2, sr(1 + \delta_t) + (\eta_k + 1)\hat{k})\), the slope of which is \(1/\eta_m\). It intersects with the productivity regime function of investment goods. The height of this intersection \((P_1)\) shows the labour productivity growth rate of investment goods \((\rho_1)\). The horizontal coordinate value of this intersection shows the demand growth rate of investment goods.

Based on Figure 9, we can understand how the asset price Keynesianism affects demand growth and productivity growth through cumulative causation.

The important point is the effect of the increase in trade deficit and international capital inflow on cumulative causation. Hereafter, based on the fact in the United States shown in Figure 7, we assume that the two external fund dependence rates \((\delta_i, \delta_c)\) have same sign, that is, we consider a case in which external fund dependence rates are identical to foreign fund dependence rates.

As shown in Figure 9 and equations (15) and (16), when the external fund dependence rate of the private business sector \((\delta_t)\) is positive, the capital accumulation effect is large as compared to when \(\delta_t = 0\), and the demand growth rate for each goods is also large. In other words, foreign capital inflow to the private business sector accelerates demand growth. Conversely, when \(\delta_t\) is negative, that is, the net capital outflow occurs in the private business sector, the demand growth rates are small. On the other hand, the capital flow in the household and government sector does not result in such a capital accumulation effect. This is another negative effect of the asset price Keynesianism that focuses on housing.

As shown in equation (14) in Appendix 2, the ratio of the net export of investment goods to the private business investment \((\gamma)\) and the external fund dependence rate in the private business sector \((\delta_t)\) are complementary in relation to the demand structure parameter \((k)\). If we assume all other parameters are constant, an increase in either \(\gamma\) or \(k\) causes an

---

3 Like the formulation in Dixon and Thirlwall (1975), if we use explanatory variables with a one-period lag in productivity regime functions, we can explicitly show a cumulative process.

4 Uni (1998) has already explained how structural change affects demand growth and productivity growth through cumulative causation.
increase in $k$. Moreover, it causes an increase in the demand growth rate of investment goods through the demand structure change effect and the relative price change effect (The demand growth rate of consumption goods is lowered slightly). When these two parameters rise simultaneously, these effects are strengthened further. However, even if $\delta_I$ increases, when $\gamma$ decreases at the same rate, the demand structure parameter $k$ remains constant. Namely, when this expansion of trade deficit does not concentrate on consumption goods but occurs with regard to investment goods, the demand structure change effect and the relative price change effect are offset.

Figure 10 shows the demand structure parameter ($k$) and its components. The demand structure parameter tended to decrease gradually in the 2000s. The thin dotted line shows the size of the first term $((1 + \delta_I)s(1 + \gamma))$ in the right-hand side of the equation (14). The distance of the bold solid line and this thin dotted line shows the size of the second term of the equation (14). The decrease in the demand structure parameter in the 2000s is chiefly caused by the decline of the first term. Namely, the decrease in $k$ is chiefly caused by changes in the private business sector, such as decline in the propensity to save ($s$), the external fund dependence ($I\delta_I$), and the export rate of the investment goods ($\gamma$). As shown in Figure 6, decline in the export rate is significant. The negative value of the export rate means that imports exceed exports with regard to investment goods, especially for machinery products. The weakening of the US international competitiveness with regard to machinery products became evident in the 1980s. This weakening was suspended by the depreciation of the dollar after the Plaza Accord in 1985. However, the decline in the export rate in the 2000s shown in Figure 6 suggests that the US machinery products began to weaken again in terms of international competitiveness, after the Reverse Plaza Accord in 1995.

As shown in Figure 6, the foreign capital inflow to the household and the government increased rapidly in the 2000s. This increase contributes to the increase in the second term of the right-hand side of the equation (14) and the demand structure parameter ($k$). However, it did not lead to a remarkable increase in the second term of the equation (14) due to a decrease in other parameters.
Source: Calculated chiefly from the data of the final demand in BEA, *the U.S. Input-Output Tables* (we excluded the imputed rent from the final demand). The data on the amounts of the profit, the residential investment, and the imputed rent were obtained from BEA, *NIPA*. There is discontinuity in data between 1997 and 1998 due to the following change of industrial classifications from SIC to NAICS. Before 1997, investment goods consists of ‘Construction’, ‘Industrial machinery and equipment’, ‘Electronic and other electric equipment’, ‘Motor vehicles and equipment’ and ‘Other transportation equipment’. Since 1998, it has consisted of ‘Construction’, ‘Machinery’, ‘Computer and electronic products’, ‘Electrical equipment, appliances, and components’, ‘Motor vehicles, bodies and trailers, and parts’, ‘Other transportation equipment’ and ‘Computer systems design and related services’.

We can calculate elasticity of profit rate \((\eta_m, \eta_k)\) using the data of the demand structure parameter \((k)\) and the capital intensity ratio \((m)\). Moreover, using the data of \(\eta_m, \eta_k\), we can measure the capital accumulation effect and the demand structure change effect shown in equation (15) and Figure 9. The result is shown in Table 3.

The capital accumulation effect \(sr(1+\delta_i)\) in the 2000s is less than that it was in 1998 by about 1 percent point due to a decline in the propensity to save \((s)\) and the external fund dependence rate \((\delta_i)\). Moreover, the demand structure change effect \((1+\eta_k)\hat{k}\) is negative because the demand structure parameter \((k)\) decreased in the 2000s. In addition, the elasticity \((\eta_m)\) related to the relative price change effect is almost constant.

For instance, the demand regime function of investment goods in 1998 and 2005 is as follows. The demand regime function of investment goods in the 2000s shifted leftwards compared to its position in the 1990s, as shown in Figure 8.

\[
g_1 = 2.6\% + 0.503(\rho_1 - \rho_2) \quad \text{(Assuming } \rho_2 = 2\%, \ g_1 = 1.6\% + 0.503\rho_1)\]
Although the increase in foreign capital inflow, the financial innovation such as securitisation of loan assets, the strong-dollar policies and the like contributed to steepening the asset price regime, they contributed to the leftward shift in the demand regime.

Table 3. Elasticity of Profit Rate, Capital Accumulation Effect and Demand Structure Change Effect

<table>
<thead>
<tr>
<th>Year</th>
<th>$\eta_m$</th>
<th>$\eta_k$</th>
<th>$\hat{k}$</th>
<th>Capital accumulation effect</th>
<th>Demand structure change effect</th>
<th>Sum of two effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>0.477</td>
<td>0.025</td>
<td>-0.009</td>
<td>3.5%</td>
<td>-0.9%</td>
<td>2.6%</td>
</tr>
<tr>
<td>1992</td>
<td>0.531</td>
<td>0.017</td>
<td>-0.009</td>
<td>2.7%</td>
<td>-0.9%</td>
<td>1.8%</td>
</tr>
<tr>
<td>1997</td>
<td>0.471</td>
<td>0.020</td>
<td>-0.009</td>
<td>4.6%</td>
<td>-0.9%</td>
<td>3.6%</td>
</tr>
<tr>
<td>1998</td>
<td>0.503</td>
<td>0.011</td>
<td>-0.021</td>
<td>4.7%</td>
<td>-2.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>2001</td>
<td>0.528</td>
<td>0.008</td>
<td>-0.021</td>
<td>3.9%</td>
<td>-2.1%</td>
<td>1.8%</td>
</tr>
<tr>
<td>2003</td>
<td>0.530</td>
<td>0.013</td>
<td>-0.021</td>
<td>3.5%</td>
<td>-2.1%</td>
<td>1.4%</td>
</tr>
<tr>
<td>2005</td>
<td>0.511</td>
<td>0.008</td>
<td>-0.021</td>
<td>3.8%</td>
<td>-2.1%</td>
<td>1.7%</td>
</tr>
<tr>
<td>2007</td>
<td>0.516</td>
<td>0.002</td>
<td>-0.021</td>
<td>4.3%</td>
<td>-2.1%</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

Source: $\eta_m$ and $\eta_k$ are calculated using the following data of $\hat{k}, m, \lambda$ based on equation (18) and (19). The value of $\hat{k}$ is indicated in Figure 5. $m = h_1 v_2 / (h_2 v_1)$ is calculated using the vertically integrated labour input coefficients ($v_1, v_2$) mentioned in the note of Table 1 and the vertically integrated productive capacity ($h_1, h_2$) measured as follows. Using BEA, the U.S. Input-Output Tables, we integrated vertically real capital stock by industry calculated from Table 3.1ES 'Current-Cost Net Stock of Private Fixed Assets by Industry' and Table 3.2ES 'Chain-Type Quantity Indexes for Net Stock of Private Fixed Assets by Industry' in BEA.

7. Conclusion

The growth regime in the United States since 1990 has been analysed frequently as a finance-led growth regime. In fact, huge foreign capital inflows, financial innovations such as the securitisation of loan assets, and strong-dollar policies, among other occurrences, have substantially increased the sensitivity of asset prices to the real economy. At the same time, the growth of the real side of the economy slowed in the 2000s, especially as the financial bubble became more obvious.

According to our analysis, the cause for this slowdown was not a downward shift in the productivity regime, but a leftward shift in the demand regime. Since the productivity regime shifted upwards, it was supposed to accelerate the real economic growth, if the position of the demand regime did not change. The direct factors contributing to the leftward shift in the demand regime included a reduction in the ‘capitalist’s propensity to save’, an expansion of trade deficit in machinery products, and a change of destination of foreign capital inflow. The
third of these relates to the shift from the stock-price bubble to the housing bubble, in line with the expansion in the securitisation of loan assets.

The effects of these factors on the demand regime are summarised as follows. Foreign capital inflows to the private business sector increased the capital accumulation effect and contributed to a rightward shift in the demand regime of both investment goods and consumption goods. As a result, these inflows prompted increases in both the demand growth rate and the productivity growth rate. However, foreign capital inflows to the household and government sectors do not tend to have such a capital accumulation effect. For instance, the foreign capital inflow to the United States in the form of foreigners' purchases of securitised housing loans has not led to a capital accumulation effect, because it flowed into the household sectors.

With regard to the demand structure change effect, it is positive and contributes to a rightward shift in the demand regime of investment goods, in the following case. Structural change in the final demand due to foreign capital inflows—corresponding to an expansion in the trade deficit, but only in consumption goods—brings about high productivity growth and high demand growth for investment goods. However, if the trade deficit expands not only in consumption goods but also in investment goods, the demand structure change effect might be negative, and the demand regime of investment goods might shift leftwards. To this extent, this positive capital accumulation effect would be offset. For instance, the US economy of the 2000s resembles this situation; that is, the US machinery products, including automobiles, weakened in terms of international competitiveness under the strong dollar, following the Reverse Plaza Accord in 1995. Moreover, in the 2000s, since most foreign capital flowed not to the private business sector but to the household and government sectors, the capital accumulation effect was small.

Consequently, although foreign capital inflows increased greatly in the 2000s, the demand regime of investment goods shifted leftwards, compared to its position in the 1990s, and demand growth slowed. Thus, although huge foreign capital inflows, financial innovations, and strong-dollar policies, among other factors, substantially raised asset prices, they did not bring about a virtuous cycle in the real economy. The slowdown in real economic growth causes a sharp fall in asset prices whenever they are strongly sensitive to the real economy; thus, a structural crisis emerged. Asset prices declined, simultaneous with a contraction in the real economy since 2007.

Appendix 1. Formulation of productivity regime

Variables with a suffix M relate to machinery and equipment, and variables with a suffix C relate to buildings and structures. Variables with a suffix M + C relate to the entire
investment goods. The notation is as follows. $L$: the amount of labour, $Y$: the quantity of output, $\rho$: the labour productivity growth rate, $g$: the output growth rate, $\alpha$: the share of machinery and equipment in the total output of investment goods, $\mu$: the share of machinery and equipment in the total amount of labour engaged in the production of investment goods. The labour productivity of the investment goods is decomposed as follows. A hat above a variable indicates the growth rate of that variable.

$$\frac{Y_M + Y_C}{L_M + L_C} = \frac{L_M}{L_M + L_C} \cdot \frac{Y_M}{L_M} + \frac{L_C}{L_M + L_C} \cdot \frac{Y_C}{L_C}$$

Therefore, the labour productivity growth rate of investment goods is decomposed as follows.

$$\rho_{M+C} = \alpha \left( \frac{L_M}{L_M + L_C} + \frac{Y_M}{L_M} \right) + (1-\alpha) \left( \frac{L_C}{L_M + L_C} + \frac{Y_C}{L_C} \right)$$

$$= \alpha (\hat{\mu} + \rho_M) + (1-\alpha) \{ (1-\mu) + \rho_C \} = \frac{\alpha - \mu}{1-\mu} \hat{\mu} + \alpha \rho_M + (1-\alpha) \rho_C$$

In fact, since the values of $\alpha$ and $\mu$ are similar, the value of $\frac{\alpha - \mu}{1-\mu}$ is small. In addition, $\hat{\mu}$ is also small. $\alpha$ is 58%, $\mu$ is 41%, and $\hat{\mu}$ is –0.5% on the average in the United States between 1987 and 97. Therefore, the term $\frac{\alpha - \mu}{1-\mu} \hat{\mu}$ can be abstracted. Then,

$$\rho_{M+C} = \alpha \rho_M + (1-\alpha) \rho_C \quad (1)$$

The output growth rate of investment goods ($g_{M+C}$) is decomposed as follows.

$$g_{M+C} = \hat{Y}_M + \hat{Y}_C = \alpha g_M + (1-\alpha) g_C \quad (2)$$

The productivity regime function of machinery and equipment is shown as follows.

$$\rho_M = a_M g_M + b_M \quad (3)$$

Substituting equation (1) and (2) in equation (3) and arranging, the productivity regime function of the investment goods is transformed as follows.

$$\rho_{M+C} = a_M g_{M+C} + ab_M + (1-\alpha) \rho_C - a_M (1-\alpha) g_C \quad (4)$$

According to this equation, when both the labour productivity growth rate ($\rho_C$) and the output growth rate ($g_C$) of buildings and structures are nearly zero, the last two terms in the right-hand side of equation (4) can be abstracted. However, $g_C$ is large in housing boom and contributes to lowering the size of the constant in the productivity regime of investment goods. This is a negative effect of the asset price Keynesianism that focuses on housing.

**Appendix 2. Formulation of demand regime**
Using Pasinetti’s (1973, 1981) vertical integration, we construct a two-sector model that consists of investment goods (commodity 1) and consumption goods (commodity 2); we derive the demand regime from this model.

\( A \) denotes the 2 × 2 matrix of intermediate input coefficient. \( \ell = [\ell_1 \ \ell_2] \) denotes the amount of labour directly required to obtain one unit of each commodity. Similarly, \( B = [B_1 \ B_2] \) denotes the amount of private business capital stock directly required to obtain one unit of each commodity. Vertical integration is done as follows. \( I_n \) is the identity matrix.

\[
v = \ell (I_n - A)^{-1} \quad H = B (I_n - A)^{-1}
\]

\( v = [v_1 \ v_2] \) represents the amount of labour directly and indirectly required to obtain one unit of each commodity as final demand. Pasinetti calls it ‘vertically integrated labour input coefficient’. Hereinafter, we call it the ‘labour input coefficient’. We regard the decreasing rate of the ‘vertically integrated labour input coefficient’ as the ‘labour productivity growth rate’ and represent it as \( \rho_1, \rho_2 \). \( H = [h_1 \ h_2] \) shows the amount of private business capital stock directly and indirectly required to obtain one unit of each commodity as the final demand. Pasinetti calls it ‘vertically integrated productive capacity’, and hereinafter, we call it ‘capital coefficient’.

\( p \) denotes the price of the commodity 1 measured with commodity 2 as the numéraire. \( \omega \) and \( r \) represent the wage rate and the profit rate respectively, which are assumed to be uniform in the two sectors. Since the commodity 2 is a consumption good, this wage rate (\( \omega \)) is the real wage rate. Price equations are as follows:

\[
\begin{align*}
p &= v_1 \omega + ph_1 r \\
1 &= v_2 \omega + ph_2 r
\end{align*}
\]

The final demand \( (D) \) is represented by the following 2 × 3 matrix.

\[
D = \begin{bmatrix}
p(C_1 + F_c) & p(I + F_i) & pE \\
C_2 & 0 & -p(E + F)
\end{bmatrix}
\]

The first column of this matrix \( (D) \) shows expenditure of the household and the government. In this paper, housing, consumer durables, and public capital stock are not included in the private business capital stock that entails profit. The construction and purchase of those are represented by a scalar \( (C_1 + F_c) \). \( C_1 \) is the expenditure from the internal funds of the household and the government. \( F_c \) is expenditure from the external
funds, financed by the housing loan and government bond issue, etc. \( \delta_c = F_c / C_1 \) denotes the ratio of externally financed expenditure to internally financed expenditure, or the ‘external fund dependence rate’ of the household and government sector. \( C_2 \) represents consumption expenditure of the household and the government. \( \beta \) represents a share of \( C_1 \) in the total expenditure of the household and the government with the exclusion of the part financed by external funds \( (F_c) \), namely, \( \beta = pC_1 / (pC_1 + C_2) \) and \( (0 < \beta < 1) \). If the price elasticity of the expenditure to the commodity 1 is one, \( \beta \) is not influenced by the change in price.

The second column of the final demand matrix \( (D) \) shows investment of the private business sector. We assume that this domestic investment consists of only the commodity 1, and its quantity is shown by a scalar \( (I + F_I) \). \( I \) represents a self-financed part and \( F_I \) represents a part financed by external funds such as bank borrowing and the issue of shares or bonds, etc. \( \delta_i = F_i / I \) denotes a ratio of the externally financed investment to the internally financed investment, or the ‘external fund dependence rate’ of the private business sector. \( F = F_c + F_I \) represents the quantity of the net foreign capital inflow if \( F \) is positive. If it is negative, its absolute value represents the quantity of the net capital outflow. We assume that both domestic investment \( (I + F_I) \) and the part of it that is self-financed \( (I) \) are positive. Therefore, \( \delta_i = F_i / I > -1 \). Similarly, \( \delta_c = F_c / C_1 > -1 \).

The third column of the final demand matrix \( (D) \) shows foreign trade. The amount of the net export of commodity 1 is represented by \( pE \) (when it is negative, its absolute value means net import). The above-mentioned amount of net capital inflow \( (pF) \) (if it has a negative value, it indicates net capital outflow) is equal to the amount of the trade deficit (trade surplus, in case of net capital outflow). Therefore, the amount of the net export of the commodity 2 is represented by \( -p(E + F) \). We assume that this economy has the comparative advantage with regard to commodity 1, therefore, \( pE > -p(E + F) \). \( \gamma \) represents a ratio of the net export of commodity 1 to private business investment, namely, \( \gamma = E / (I + F_I) \).

In addition, \( K \) denotes the total quantity of commodity 1 that exists as private business capital stock. Its utilization rate is assumed to be 100% for simplicity.\(^5\) The quantity equations are as follows. Here, a scalar \( N \) represents labour force population and a scalar \( u \) represents the unemployment rate. The amount of total labour demand \( (L) \) is shown by \( (1-u)N \).

\[
\begin{align*}
    h_1(C_1 + F + I + E) + h_2(C_2 - pE - pF) &= K \\
\end{align*}
\]

\(^5\) Since we examine a middle- and long-term change that can be observed even if the business cycle is abstracted, it is permissible to assume that the utilization rate is constant. The conclusion does not change even if this constant utilization rate is assumed to be less than 100%.
\[ v_1(C_1 + F + I + E) + v_2(C_2 - pE - pF) = L = (1-u)N \quad (8) \]

Next, we formulate middle- and long-term relationships between the income and the expenditure. We assume that a part of the profit income is invested and the residue is consumed. The ratio of the investment to the profit income, that is, ‘capitalist’s propensity to save’, is represented by \( s \) \( (0 < s < 1) \). All of the wage income is assumed to be consumed.

\[ srpK = pI \quad (9) \]

\[ \omega L + (1-s)rpK = pC_1 + C_2 \quad (10) \]

Since the total income is constantly equal to the total final demand, that is, the sum of left-hand side of the above two equations is constantly equal to the right-hand side, an independent equation is one between the two equations.

Consequently, there are five independent equations among the equations (5)–(10). The number of unknown variables is six: \( I, C, p, \omega, r, u \). Therefore, one more equation is necessary to conclude this system of simultaneous equations. There are some candidates for this equation, such as exogenously giving the level of the profit rate, the wage rate, or the wage share. This equation works as a constraint in relation to the determination of the price and income distribution.

We assume the constraint that the wage share is constant\(^6\). We take into account the fact that the wage share at the macroeconomic level is constant in the long term in most advanced countries. Concretely, we assume that a ratio of the wage income \( (\omega L) \) to the profit income \( (rpK) \) has a constant value \( (\lambda) \) (hereafter, we call it ‘wage-profit ratio’). As a result, both the profit rate and the wage rate become endogenous variables.

\[ \frac{\omega L}{rpK} = \lambda \quad \text{(given and constant value)} \quad (11) \]

By adding this constraint, the simultaneous equations system is closed, with six unknown variables and six\(^7\) independent equations. When initial values (at \( t = 0 \)) of the amount of capital stock \( (K) \), the input coefficients \( (v_1, v_2, h_1, h_2) \) and the parameters regarding demand structure \( (s, \lambda, \beta, \gamma, \delta_c, \delta_t) \) are given, we can solve this simultaneous equation system, and obtain the quantity of output of each commodity, the amount of employment, the profit rate, the wage rate, and the relative price at \( t = 0 \).

A change in the capital stock, namely, capital accumulation is shown by the following equation.

---

\(^6\) If the profit rate is assumed to be constant, the wage share at the macroeconomic level rises continuously when the labour productivity growth rate of commodity 1 exceeds that of commodity 2. Moreover, if the wage rate is assumed to be constant, the wage share declines continuously. Therefore, these two assumptions are unrealistic.

\(^7\) The basic structure of this two-sector model is similar to that of the so-called Robinson model developed by Robinson (1956) and Robinson (1962). However, an assumption concerning income distribution is fundamentally different.
Using this equation, the amount of the capital stock at \( t = 1 \) is determined. As will be discussed later, when technological change and change in the demand structure occur, the input coefficients \( (v_1, v_2, h_1, h_2) \) and the parameters relevant to the demand structure \( (s, \lambda, \beta, \gamma, \delta_c, \delta_l) \) also change. If, based on the pattern of structural change, these values at \( t = 1 \) are given, the quantity of output, the amount of employment, the profit rate, the wage rate, and the relative price at \( t = 1 \) are determined. Thus, the values of the endogenous variables at each time point are determined one after another.

First, we derive these values at any given time point. To facilitate calculation, we introduce two integrated parameters. The first one \( (m) \) consists of the input coefficients \( (v_1, v_2, h_1, h_2) \) and represents a ratio of the capital intensity of the two sectors. We call it the ‘capital intensity ratio’. Its value is positive \( (m > 0) \), and if the capital intensity of commodity 1 is equal to that of commodity 2, then \( m = 1 \). The second integrated parameter \( (k) \) consists of the demand structural parameters \( (s, \lambda, \beta, \gamma, \delta_c, \delta_l) \). We call it the ‘demand structure parameter’. Its value is \( k = 0 < k < \lambda + 1 \).

\[
m = \frac{h_1}{v_1} / \frac{h_2}{v_2} = \frac{h_1 v_2}{h_2 v_1} \quad \text{(13)}
\]

\[
k = \frac{p(C_1 + F + I + E)}{r p K} = (1 + \delta_l) s (1 + \gamma) + (1 + \delta_c) \beta (\lambda + 1 - s) \quad \text{(14)}
\]

The right-hand side of equation (14) comprises two terms. The first term is what is determined by behaviour of the private business sector, which depends on the willingness to invest, the external fund dependency, the export competitiveness, etc. The second term is what is determined by the behaviour of the household and the government, which depends in turn on the external fund dependency and the willingness to spend for durable consumer goods, housing, and social capital.

In the long term in advanced countries, the changes in the capital coefficients are quite small compared with the change in labour productivity. Therefore, in the following analysis, we assume that \( h_1 \) and \( h_2 \) are constant. Moreover, with regard to the labour productivity growth rate \( (\rho_1, \rho_2) \), we assume \( \rho_1 > \rho_2 \) taking into account the fact in the recently developed countries. In this case, as the growth rate of the capital intensity ratio is represented by \( \dot{m} = \rho_1 - \rho_2 \), the capital intensity ratio \( (m) \) increases. Hereafter, a hat above a variable shows the growth rate of that variable.

As shown in Uni (2010), from these equation and assumptions, the demand growth rate of
commodity 1 \((g_1)\) is derived as follows.

\[ g_1 = sr(1 + \delta_j) + \eta_m(\rho_1 - \rho_2) + (\eta_k + 1)\hat{k} \tag{15} \]

Here, \(\eta_m = \frac{\partial r}{\partial m} \frac{m}{r} = \frac{2m\lambda(\lambda + 1 - k)}{\sqrt{A^2 + 4m\lambda}} \]
\[ \] \[ \eta_k = \frac{\partial r}{\partial k} \frac{k}{r} = \frac{k(1 - m)[A + \sqrt{A^2 + 4m\lambda}]}{\sqrt{A^2 + 4m\lambda} [2m + A + \sqrt{A^2 + 4m\lambda}]} \]

\(\eta_m\) represents the elasticity of the profit rate to the capital intensity \((m)\) and \(\eta_k\) represents the elasticity of the profit rate to the demand structure parameter \((k)\). As Uni (1998) proved, the range of the former is \(0 < \eta_m < 1\) and, in the case of \(m < 1\), the range of the latter is\(^9\) \(\eta_k > 0\).

On the other hand, the demand growth rate of commodity 2 \((g_2)\) is as follows.

\[ g_2 = sr(1 + \delta_j) - \frac{h_{rk}}{1 - h_{rk}} (\hat{r} + \hat{k}) = sr(1 + \delta_j) - \frac{h_{rk}}{1 - h_{rk}} [\eta_m(\rho_1 - \rho_2) + (1 + \eta_k)\hat{k}] \tag{16} \]

It is also the sum of capital accumulation effect, relative price change effect, and demand structure change effect. However, when \(\rho_1 > \rho_2\), the relative price change effect is negative. Moreover, when the demand structure parameter \((k)\) increases, the demand structure change effect is negative. The value of \(h_{rk} = \frac{p(C_1 + F + I + E)}{p(K/h_i)}\) is close to the share of commodity 1 demand in the total final demand. Since this share is actually about 0.15–0.2 in the United States, the value of \(h_{rk} / (1 - h_{rk})\) is considered to be about 0.18–0.25. Therefore, it is perceived that the relative price change effect and the demand structure change effect with regard to commodity 2 are quite small compared with that for commodity 1.

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\(^9\) As proven in Uni (1998), when \(m > 1\), \(-1 < \eta_k < 0\). We calculated the actual value of the capital intensity ratio \((m)\) in the United States. For 2005, it is 0.94 even if capital stock in the government sector is excluded from the calculation. If it is included, the actual value of \(m\) is small. Namely, the capital intensity of commodity 1 is smaller than that of commodity 2. Takahashi, et al. (2004) shows similar results with regard to Japan, the United States and Germany in the 1970s–1990s.
Reference


