

Patterns of Business Cycles by Multipliers with and without Technology and Government: 1960–2005*

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Abstract

This paper presents the theory and empirical results of endogenous business cycle, where data and model used are consistent endogenously over years. This paper, after clarifying the fundamental relationship between business cycle and economic stages (poor, developing, and developed), first shows ‘sin’ patterns of business cycle for eight countries, using theoretical/endogenous capital and returns measured at the macro level based on national disposable income *NDI* by sector. The data-sets KEWT 1.07, 1960–2005, used for this purpose are all theoretical (except for several actual values whose source is *IFS*, IMF). The author found that the core of business cycle is the ratio of marginal consumption to *NDI* and this ratio by fiscal year is tightly related to the theoretical change in endogenous technology. Marginal actual consumption and marginal theoretical wages fluctuate positively or negatively by country, based on national taste at the macro level (instead of individual’s utility). Also author found that the magnitude of budget deficits

* This paper was first presented at the International Atlantic Economic Conference, Savannah, Oct 2007, when KEWT (Kamiryo Endogenous World Table) 1.07 was arranged. After that, the author published KEWT 2.08, 1990–2007, to 58 countries by sector, where equilibrium and quasi-equilibrium by year were clarified in the real assets. Nevertheless, KEWT 1.07 is still useful to the analysis of business cycle, since aggregate equilibrium of KEWT 2.08 has been tested in two simple ways. When the author uses KEWT 2.08 instead of KEWT 1.07, the results are more thoroughly theoretical due to the execution of the sufficient and necessary conditions for aggregate equilibrium. Since this paper uses KEWT 1.07, the results are more realistic and nearer to the raw. This paper, therefore, is worthy of the first literature of endogenous business cycle. To supplement this paper, the author will soon summarize the relationship between real and financial assets with market values. I am thankful to Eiji Nagai of Shibuya Kogyo for the confirmation of all related results in this paper.

stirred up the private sector and business cycle and that under no endogenous technology, there is neither business cycle nor economic stage.

JEL: E20, E30, O40

1. Character of data used in the endogenous growth model

Equilibrium of an economy holds by fiscal year with given balance of payments and budget surplus/deficit, where consumer goods and producers' goods are balanced in the real assets. Business cycle occurs when a shock is needed for recovering equilibrium immediately, which the author calls endogenous business cycle. The relationship between aggregate equilibrium and business cycle has not been discussed endogenously to technology.¹⁾ A technology shock is expressed by a sudden change in the rate of technological progress, which in turn causes an immediate change in the marginal propensity to consume. The necessary and sufficient conditions of equilibrium are shown using fundamental values such as net investment and endogenous parameters (*beta*, *delta*, and *lambda*) by sector (see soon below, and also see Appendix A8–A10). These conditions are immediately applied to endogenous business cycle (hereunder simply, business cycle). These conditions were discussed in “Endogenous Data-Sets of KEWT 2.08” in Environmental Economics at IEEU, Sep 2008, and the author does not repeat these in detail.

First in this paper, the author summarizes the character of data used for the endogenous growth model and second, the core of this model. The author uses

1) For example, V. V. Chari, Patrick J. Kehoe, and Ellen G. McGrattan (2007) present Business cycle accounting, yet based on econometrics for two types of wedges or distortions. Earlier, Lars Peter Hansen and James J. Heckman (1996, 95–97) discuss the real business cycle empirical method in practice. Their business cycle is based on actual data and stochastic with expectations, although they do not show actual results. Theoretical data are equilibrium-oriented so that the resultant endogenous business cycle is recovery-oriented.

the data-sets of KEWT,²⁾ where several actual/initial values by year are population L , consumption C , saving S , (accordingly national disposable income $Y = NDI$ ³⁾), net investment I , and those by sector (using subscripts; government G and private PRI). The balance of payments BOP (or the current external balance if net primary income from abroad is unknown) is shown as $S - I$, budget deficit as $S_G - I_G$, the difference between saving and net investment as $S_{PRI} - I_{PRI}$, where the BOP equals $(S_G - I_G) + (S_{PRI} - I_{PRI})$. The author's endogenous growth model has a set of structural-reduced equations useful to both fiscal and recursive years. This paper uses these equations by fiscal year in the long run, not referring to the transitional path, where recursive programming by recursive year is explained. The consistency between data and model is justified by two tests in KEWT 1.07, the matching test by year and the smoothening test for 46 years, where the data of national accounts are consistent with the data used for the Cobb-Douglas production function by fiscal year. As a result, wages, returns, and capital (stock) by fiscal year and by sector are not actual but endogenously measured at the macro level. No econometrics approach, probabilities, expectations, nor regression analysis is made in the author's endogenous model.

Accordingly, the relative share of capital or labor, the capital-output ratio, and the rate of return vary theoretically by fiscal year (recall, Solow, R. M.(1958)). The share of labor in Phelps Brown, E. H. and Hart, B. P. E. (1952) and the ratio of NDI to GDP is now settled theoretically. Hypothesis between con-

2) Its original data come from *International Financial Statistics Yearbook* and *Government Finance Statistics Yearbook*, International Monetary Fund.

3) Disposable income is shown as $Y = W + \Pi = C + S$, where actual wages and actual returns are converted each to theoretical, where the equivalent of three aspects (Meade, J. E., and J. R. N. Stone, 1969) is justified. As a result, the data of national accounts are consistent with the data used for the Cobb-Douglas production function at the discrete time.

sumption and saving by Spiro A. (1963, p. 480) is tested by the wage function of consumption formulated in the author's endogenous model. The introduction of the capital-output ratio into the multiplier first shown by Tinbergen, J. (1956) is now theoretically and empirically examined for business cycle. Therefore, the author does not need a plenty of indicators of business cycle in both real and financial assets as historically shown by Zarnowitz, V. (1996). Yet, the author attaches vital importance to the neutrality of financial assets that connects the rate of return as a natural rate of return in the real assets with the central bank interest rate or the market rate. This is because the financial assets and the market stir up business cycle in the short run as if the financial assets have a power much more positive than the real assets. In the long run, it is proved in true that the financial assets cannot be a surrogate for the real asset (for money neutrality, see Lucas, Robert E., Jr, 1995).

Endogenous business cycle in this paper contrasts with business cycle in King, R. G., Plosser, C. I., and Rebelo, S. Y. (1988) that clarifies business cycle based on the exogenous neoclassical model. Let the author summarize endogenous business cycle based on the characteristics of the endogenous growth model. Here 'endogenous' implies that the rate of technological progress is measured by using parameters within the model. If education, R & D, and/or learning by doing are used for the rate of technological progress, these do not imply 'endogenous' because these are not wholly connected with other parameters within the model consistently in the long run. The author's model smells out and formulates three hidden parameters, *beta*, *delta*, and *lambda*, so that the Cobb-Douglas production function holds by fiscal year. The *beta* (or, $1-\beta$) shows quantitative (or, qualitative) investment to net investment as formulated in the set of structural-reduced equations (see *PRSCE* 49 (Sep), 2008, and Appendix at the end). Net investment by fiscal year is divided into quantitative and qualitative net investment, where the rate of technological progress is measured

using qualitative net investment. Capital stock K_t by year is the sum of capital K_{t-1} and net investment before dividing it into two components, I_t . The level of technology A or total factor productivity TFP is calculated using $k^{1-\alpha}/\Omega$, where $\Omega = K/Y = k/y$, as shown in $Y = TFP \cdot K^\alpha \cdot L^{1-\alpha}$ or $y = TFP \cdot k^\alpha$.⁴⁾

In the above model, the author needs capital and returns/rents consistent with other data at the macro level by sector. On this requirement, the author introduces two parameters: the ratio of the discount rate of consumption to the discount rate of saving, (rho/r) , and the ratio of the theoretical wage rate to the discount rate of saving, (r/w) , where the discount rate of saving equals the theoretical rate of return (that corresponds with the natural rate of interest). Two related equations are: *One* is $1-\alpha = c/(rho/r)$, where c is the ratio of consumption to output (the propensity to consume). This equation is not an accounting identity yet, commonly set $(rho/r) = 1.8075c^2 - 2.2549c + 1.4688$ in KEWT due to the relationship between *alpha* and three savings of corporate, dividends, and households. The range of c differs by country so that the same national taste function to consumption, $(rho/r)(c)$, prevails in most countries.

The other equation is $k = (\alpha/(1-\alpha))/(r/w)$, where k is the capital-labor ratio. This equation is an accounting identity and set so as to be consistent with the above $K_t = K_{t-1} + I_t$ ⁵⁾ in capital. For the government sector, under an assump-

4) TFP changes from ‘residual’ accepted in the literature to the product of ‘ B ’ as $(1-\beta)/\beta$ and the capital-labor ratio, with each exponent. If the current year starts with constant returns to capital (measured by the rate of return), the result of the Ak model matches that of the Cobb-Douglas production function only at convergence (see *PRSC* 49 (Sep), 2008). Both the author’s above Ak model and the AK model discussed by Hussein K. and Thirlwall, A. P. (2002) each hold under constant returns to capital all through the transitional path.

5) In *JES* 12 (Feb), 2009, the author discusses, from the viewpoint of capital stock, the differences between KEWT data-sets and those of Economic Social Research Institute, Cabinet Office, Japan, and Bureau of Economic Analysis, Department of Commerce, the US, each in 1960–2005.

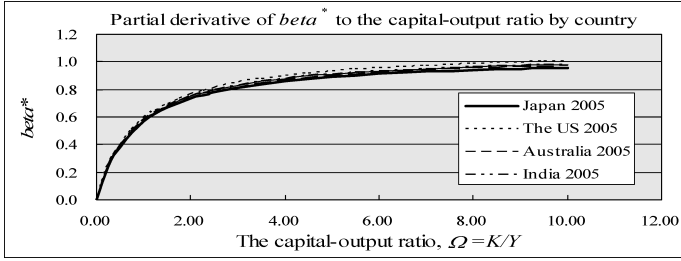
tion that government is neutral to national taste (where theoretical wages = consumption), taxes equal government NDI or output and government returns equal government saving: $T_{AX} = Y_G$ and $\Pi_G = S_G$. If government saving is minus due to huge deficit, the rate of return is minus, which reduces government income and causes assets-deflation starting with the government sector.⁶⁾ The data-sets in KEWT 1960–2005 satisfy the above model and requirement by country and by sector.

2. The criterion to determine the economic stage

This section first states how to classify the economic stage into poor, developing, and developed, using fundamental equations at convergence in the transitional path. This is a preliminary step to measure business cycles by country. The distinction of the economic stage with business cycle is one of contributions of this paper. The author's idea is that economic growth and business cycle by country are maintained by the adjustment of the marginal actual propensity to consume, $\Delta c \equiv \Delta C / \Delta Y$, where the capital-output ratio is deeply involved.

First, what determines the economic stage by country in the author's model? The level of the theoretical capita-output ratio determines the three differences between poor, developing, and developed/advanced. This is proved by the relationship between the qualitative investment to net investment, β , and the

6) My assumption is that the national taste at the government sector is neutral to theoretical wages. This is shown as $(rho/r)_G=1.0$; government theoretical wages equal government actual consumption. As a result, government saving equals government returns/rents. When government saving is minus, this makes government assets/capital to decrease, which implies that government assets-deflation will spread over the total economy. This idea was first tested by the author in *JES* 10 (Feb), 2007, using thirty countries 1995–2004 and classifying the rate of saving into tree groups. The author then clarified "How to simulate Budgeting" in *JES* 12 (Sep, 1), 2008, starting with an exogenous framework of De Grauwe, P. (2003).



This shows that an economy has a common base for technological progress in the world economy.

Data source: KEWT 1.07

Figure 1 Partial derivative of the quantitative investment to total investment at convergence, β^* , and the capital-output ratio by country

capital-output ratio, Ω , each at convergence: $\beta^* = \frac{\Omega^* (n(1-\alpha) + i(1+n))}{i(1-\alpha) + \Omega^* \cdot i(1+n)}$ and

$\Omega^* = \frac{\beta^* \cdot i(1-\alpha)}{i(1-\beta^*)(1+n) + n(1-\alpha)}$, where the minimum level of $\Omega^* = \Omega(0)$ is

assumed in the model. $\Omega^* = \Omega(0)$ implies that the maximum rate of return corresponds with the minimum capital-output ratio at convergence. This relationship is shown typically by **Figure 1**, using the partial derivative of β^* to the

capital-output ratio is $\frac{\partial \beta}{\partial \Omega} = \frac{c - b \cdot \beta}{a + b \cdot \Omega}$.⁷⁾

In Figure 1, the horizontal asymptote of β^* to the capital-output is 1.0 with an infinite value of the capital-output ratio. If the capital-output ratio is below 1.5, the corresponding β^* increases or ‘ $1 - \beta^*$ ’ decreases rapidly in the hyperbolic curve. First, if the capital-output ratio is ‘below 1.0,’ the corresponding β^* increases or ‘ $1 - \beta^*$ ’ decreases more rapidly than the case of

7) Set $a = i(1-\alpha)$, $b = i(1+n)$, and $c = n(1-\alpha) + i(1+n)$ in the above β^* equation.

The author is thankful to Dr. Yoshimi Fujimoto for his help and review of the contents.

‘below 1.5.’ In this case, despite this good symptom to technology, the ratio of net investment to output i is usually extremely low in the real world. This is the poor stage as shown in many African countries. Second, if the capital-output ratio is between 1.0 and 1.5, the ratio of investment to output i increases rapidly by fiscal year by country. This is the developing stage, where a high growth rate of output seems to robustly continue in the long run, but in the real world not. Third, if the capital-output ratio is above 2.0, the corresponding β^* becomes close to 1.0 or ‘ $1-\beta^*$ ’, becomes close to zero, where a high level of technological progress is difficult to continue unless physical capital turns to human capital enormously in the long run. Most developed countries suffer from this difficulty. This is plainly related to aggregate equilibrium through the necessary and sufficient condition of $0 < \beta < 1$ or $\Omega < i/n > 0$ (see Appendix A8). Under the growth rate of population n , the value of $\Omega \cdot n$ must be relatively lower than the ratio of net investment to output, i . Under no technology, capital is completely in proportion to net investment; even this case cannot raise the upper limit of the capital-output ratio.

In short, developed countries have a restriction that they cannot easily raise the marginal capital-output ratio. The author concludes that if the capital-output ratio at the private sector is roughly 2.0, the country is competitive and that if the capital-output ratio at the total economy is 2.5, it shows an upper limit by country in the global world. This upper limit in the real world will explain the law of the conservation of the capital-output ratio in Samuelson, P. (1970), which was proved by Figure 1.

3. Equations related to patterns of business cycle

The ‘sin’ equation to determine the patterns of business cycle

Hicks J. (1950, 65–82, 170–181) formulated equations, paying attention to the multipliers and accelerators, separating the trend of consumption from the trends

of investment but, without introducing the consumption multiplier. Hicks (ibid., p.176, p.179 in Mathematical Appendix) shows ‘cos’ and ‘sin’ equations, referring to Moivre’s theorem.⁸⁾ The author does not review his equations in detail in this section. The author, however, found that Hicks’s ‘sin’ measurement to business cycle is the best among others after testing various measurements, although Hicks did not show empirical results probably due to the lack of pertinent data at those times, similarly to Tinbergen Jan (1956).

The author sets the following elements involved in a ‘sin’ equation to extract the patterns of business cycle. These elements are composed of amplitude (Am , hereafter), period (Pe , hereafter), radians \times (Rad , hereafter), topological (Top , hereafter), and business cycle (Bc , or, $B_{c(START)}$, hereafter). Each element is expressed using parameters, $a, b, c, d, e, f, g, h, j, l$, and $START$.⁹⁾ The value of fiscal year t usually starts with 1 (which corresponds with 1960 in the datasets 1960–2005; e.g., if $t = 46$, it shows 2005).

Am shows a hyperbolic curve of $Am = (1/(t-a)) + b$. Pe shows a non-linear curve of $Pe = c - (t/d)^3$. Rad shows an exponent curve of $Rad = RADIANS(t-e)$. Top shows a linear equation of $Top = f \cdot Rad + g$. Finally, business cycle, Bc , shows a sin curve of $Bc = Am \cdot SIN(Pe \cdot Rad) + Top$. If a resultant pattern of business cycle seems to be unnatural, Bc is replaced by $B_{c(START)}$, where the starting point of height is adjusted: $B_{c(START)} =$

8) For example, see the following equations to the multiplier theory and the accelerator theory, $I_n = A \sin(nh + k)$ to investment, or the combinations of cos and sin, $a = \rho \cos \theta$, $b = \rho \sin \theta$, $\rho = \sqrt{a^2 + b^2}$, where $\tan \theta = b/a$, $u_1 = \rho(\cos \theta + i \sin \theta)$, and $A_1 = k(\cos \varepsilon + i \sin \varepsilon)$.

9) In the case of the US, $a = -1$, $b = 0.3$, $c = 41$, $d = 14$, $e = 5$, $f = -0.0088$, $g = 0.1388$, $h = 0.00014$, $j = -0.00505$, and $l = 0.0265$ and $START = -400$. The values of a, b, e, h, j , and l vary by country: e.g., in the case of Japan, $a = -1$, $b = 0.2$, $e = 4.6$, $h = -0.0002$, $j = -0.0017$, and $l = 0.1926$. The author is thankful to Eiji Nagai for his tests.

$Am \cdot SIN(Pe \cdot Rad +_{START}) + Top$. Then, how is the sin equation determined using the above elements? As a criterion to determine each value of the above eleven parameters introduced into the sin equation, the author uses the trend of the growth rate of net investment of the private sector: This trend is expressed by a quadratic curve of $trend\ g_{I(PRI)} = h \cdot t^2 + j \cdot t + l$, where h , j , and l are parameters related to the trend formation.

Why did the author choose the growth rate of net investment to get the trend of business cycle? For the selection of a trend parameter fitted for business cycle, the author tested forty eight parameters 1960–2005 by sector including national disposable income NDI , the current external balance, the ratio of net investment to income, net investment, β^* , and each growth rate and others. Finally, the author decided to take the growth rate of net investment of the private sector as the trend parameter. This final decision, from the viewpoint of aggregate equilibrium, is consistent with the structural relationship among the balance of payments, deficits, endogenous growth rates in the data-sets 1960–2005 (see Appendix, and also “Endogenous Data-Sets of KEWT 2.08” in Environmental Economics at IEEU, Sep 2008). Conclusively, the author has learned a lot from the above formulation of Hicks. Therefore, the sin equation is justified as,

$$Bc = Am \cdot SIN(Pe \cdot Rad) + Top \quad \text{or} \quad B_{c(START)} = Am \cdot SIN(Pe \cdot Rad +_{START}) + Top. \quad (1)$$

Equations useful to the cause and effect analysis in business cycle

The relationship between the multiplier of Samuelson, Paul A. (1939a, b) and the consumption multiplier of Tinbergen, J. (1956) is expressed by the following equation.

$$Mc = M \cdot \Delta c \quad \text{or} \quad \frac{\Delta C}{\Delta K} = \frac{\Delta Y}{\Delta K} \cdot \frac{\Delta C}{\Delta Y}. \quad (2)$$

Or, the marginal propensity to consume is: $\Delta c = Mc/M$ or $\frac{\Delta C}{\Delta Y} = \frac{\Delta C}{\Delta K} \cdot \frac{\Delta K}{\Delta Y}$, (3)

where $\Delta c \equiv \Delta C / \Delta Y$ is the marginal propensity to consume, $M \equiv \Delta Y / \Delta K$ is the multiplier, and $Mc \equiv \Delta C / \Delta K$ is the consumption multiplier. The multiplier is exactly the inverse number of the marginal capital-output ratio $\Delta \Omega = \Delta K / \Delta Y$. Furthermore, the relationship between average and marginal is shown using the denominator's growth rate: $c(t) = c(t-1)(1/(1+g_Y)) + \Delta c(g_Y/(1+g_Y))$, where the higher the output share of government to the total economy, the stronger the influence of budget deficit on $\Delta c = \Delta C / \Delta Y$.

In Eq. 2, the author took advantage of the capital-output ratio raised by Tinbergen, J. (1956). Besides, the author found that the economic stage was determined by the range of the capital-output ratio. To the author's understanding, no one has measured theoretical capital by fiscal year in the long run (consistently with all the parameters and variables in a whole system). Once measured theoretical capital in the data-sets is, the change in technology is well involved in Eq. 2 or Eq. 3, since the marginal capital-output ratio is close to another expression of the level of technology, *TFP*. Then, why is Eq. 2 or 3 set the core of business cycle? This is proved by using the above partial derivative of β^* to the capital-output that prevails in three economic stages.

Business cycle is eventually adjusted by consumption and technology in multipliers. Business cycle straightforwardly determines its pattern by the transition of marginal consumption and marginal theoretical wages. Actual wages in *GDP* and theoretical wages in *NDI* differ by year, where the inflation rate is externally related.¹⁰⁾ Cycle's framework is divided into two parts in the three

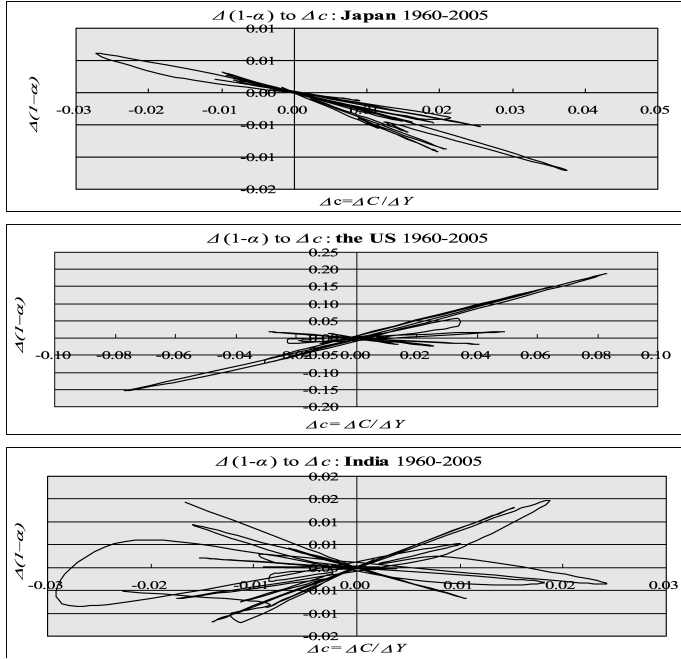
10) $p \cdot Y = r \cdot K + w \cdot L \rightarrow 1.0 = (p \cdot Y)/Y$ holds by using theoretical values. The relative price level, p , theoretically remains unchanged in the transitional path. $g_{1-\alpha} = g_w - g_y$ holds using theoretical values, to which no inflation rate is related. The difference between actual wage rate and theoretical wage rate presents a base for inflation rate ↗

transitions of economic stages: (1) Investment increases and decreases shifting from quantitative to qualitative investment and (2) *NDI* increases or decreases adjusting marginal consumption and shifting from saving to consumption. In $Mc = M \cdot \Delta c$, the author's finding is that the multiplier and the consumption multiplier move inseparably, whose tie is the marginal propensity to consume, Δc . The R^2 between M and Mc is extremely significant (0.9910 for the number of observation = 308). And interesting to say, R^2 between Δc and M is 0.00116 ($F = 0.5524$) and R^2 between Δc and Mc is 0.00119 ($F = 0.5473$). The author found real facts behind $Mc = M \cdot \Delta c$ in **Figure 2**: marginal wages and marginal consumption move widely, differently, and flexibly by country, depending on national taste and various policies including tax system policy. Without these movements between $\Delta(1-\alpha)$ and Δc , any economy cannot maintain aggregate equilibrium by fiscal year.

Recall that the relative share of capital is the product of the capital-output ratio and the rate of return: $\alpha = \Omega \cdot r$. This equation is an accounting identity and implies that each item is related to the change in technology. However, the author preferred $Mc = M \cdot \Delta c$ to $\alpha = \Omega \cdot r$ as the essence of business cycle. This is because $\alpha = \Omega \cdot r$ cannot directly explain marginal consumption. Nevertheless, *alpha* is useful to the review of marginal wages related to marginal consumption. The author will summarize this review by using the following Eqs. 4 and 5. First, when *alpha* is fixed as in the transitional path by recursive year, the rate of technological progress at the flow level, $g_A(t)$, equals the growth rate of $TFP(t)$ at the stock level, $g_{TFP}(t)$.

that is estimated by the growth rate of *CPI* (consumers' price index). Nominal interest rate = 10 year bond rate + inflation rate holds roughly in the financial market.

The above financial equation is examined by the rate of return as the natural rate of interest in the real assets. A cause of assets-deflation is traced back to huge minus returns at the government sector as in Japan, yet this influences deflation rate as a flow depending on the magnitude of money supply to offset the minus returns.



Note: The pattern of positive: the US, Australia, Russia, and China. The pattern of negative: Japan and Korea, and the pattern of flexible: India, Brazil, and Mexico.

Data source: KEWT 1.07

Figure 2 Flexible movements in the marginal wages to marginal consumption by country

$$g_A(t) = g_{TFP}(t), \text{ where} \quad (4)$$

$$g_A(t) = i(1 - \beta(t))k(t)^{\alpha - \delta(t)} \text{ and } g_{TFP}(t) = (TFP(t) - TFP(t-1))/TFP(t-1).$$

This is a good finding as a preparation to Eq. 5. Then, Eq. 5 holds as a theoretical accounting identity, similarly to Eq. 4.

$$g_A(t) = \alpha \cdot g_r(t) + (1 - \alpha)g_w(t), \text{ where} \quad (5)$$

g_r is the change in the (theoretical) rate of return, r , and g_w is the change in the (theoretical) wage rate, w . By fiscal year, the relative share of capital, α , changes. This implies that the Cobb-Douglas production function changes by

fiscal year. Since the growth rate of population or the number of employees is externally given (known), it is possible to compare the difference between the theoretical wage rate and actual wage. However, it is difficult to derive something related to inflation rate, by using the above difference (see Note 11).

Equations to find no technology

Finally, how does the author eliminate the influence of technology in the above equations? This is one of two issues in this paper and will be done by using effective labor such as

$$\tilde{A} = TFP^{\left(\frac{1}{1-\alpha}\right)}, \text{ where} \quad (6)$$

$TFP = k^{1-\alpha} / \Omega$ (which shows an endogenous base) and

$$Y = K^{\alpha} (\tilde{A}L)^{1-\alpha} = \tilde{A}^{1-\alpha} \cdot K^{\alpha} \cdot L^{1-\alpha}, \quad Y = K^{\alpha} (\tilde{A}L)^{1-\alpha} = K^{\alpha} (\tilde{A}L)^{-\alpha} (\tilde{A}L). \\ \tilde{y} = \tilde{k}^{\alpha}, \text{ where} \quad (7) \\ \tilde{y} \equiv Y / \tilde{A}L \quad \text{and} \quad \tilde{k} \equiv K / \tilde{A}L.$$

It is well known in the literature that economic growth comes from the change in technology. My interest is whether or not the capital-labor ratio becomes flat without technology. Almost flat over years will be shown using figures soon below.

4. Results of patterns of business cycle and its cause and effect analysis by country

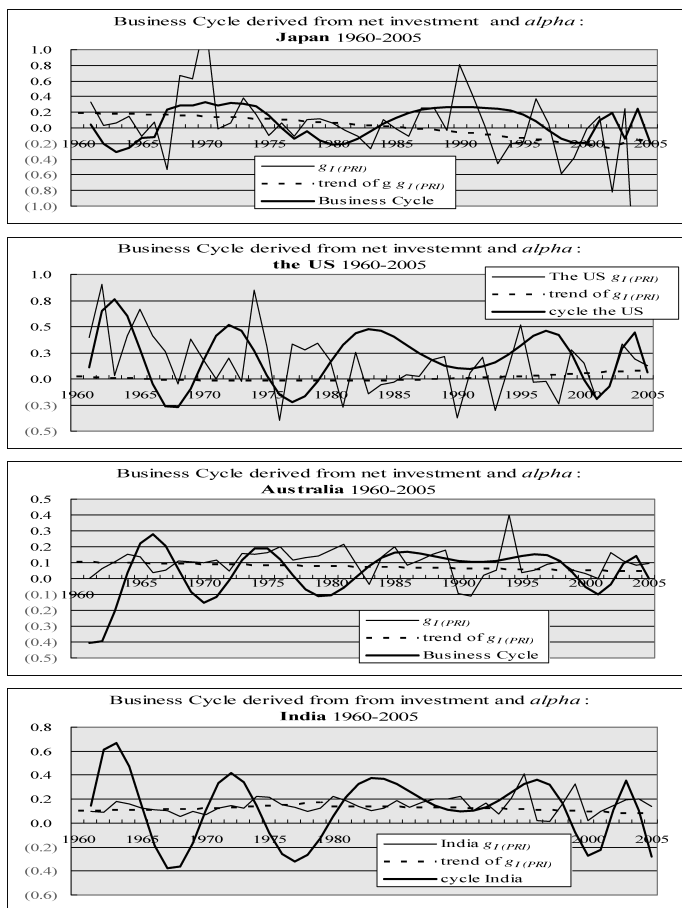
Patterns of business cycle

This section shows the trends of the growth rate of net investment in the private sector, $\text{trend } g_{I(PRI)} = h \cdot t^2 + j \cdot t + l$, and patterns of business cycle by country based on the data of KEWT. For eight countries, Figures 3 and 4 show each $\text{trend } g_{I(PRI)} = h \cdot t^2 + j \cdot t + l$ and patterns of business cycle, using the sin equation of Eq. 1.

In **Figures 3 and 4**, the above trends are classified into three stages: (1) the developed stage as in the US, Japan, Korea, Australia, (2) the developing stage as in India and China, and (3) the unique stage as in Brazil and Mexico. The trend by country differs significantly. For example, Brazil had two periods that had suffered from super inflation. Mexico contrasts with Brazil in that the interest rate has been kept high and the Mexican economy has avoided a high inflation. The US and Japan contrast in that the US economy seems to begin a little bit to recover after suffering from a long-term difficulties while the current Japan still in the mid of specific difficulties due to huge budget deficit after the 1990th and corresponding accumulation of national debts. Note that the above shows the trends between 1960 and 2005. These results suddenly have corrupted after October 2008 with the subprime loans as a turning point (for budgetary help and implication, see related papers at <http://www.riee.tv>).

Du Grauwe, P. (2005, 253-260) broadly compares the US, Japan, and Euro area in financial markets. The author points out the fact that an economy is significantly influenced by decision-making in the government sector as well as the neutrality level of financial assets. Korea has entered into the developed stage. This is one reason why the growth rate in recent Korea stays at a low level. This is justified by the character of the elasticity of β^* to Ω^* . The same will be applicable to China. China will soon fall into a turning point in economic growth. A different trend is found in India. However, India differs from China: one of reasons is that the ratio of net investment to output has been comparatively low compared with other countries.

Now the author will summarize business cycle patterns of eight countries. This is a highlight, supported by the characteristics of the data-sets. Figures 3 and 4 suggest that the sin equation differs by country: amplitude, period, topological and radians differ in detail yet, not definitely. The author noticed: (1) The patterns should not be adjusted artificially and (2) Any irregular cycle differ-

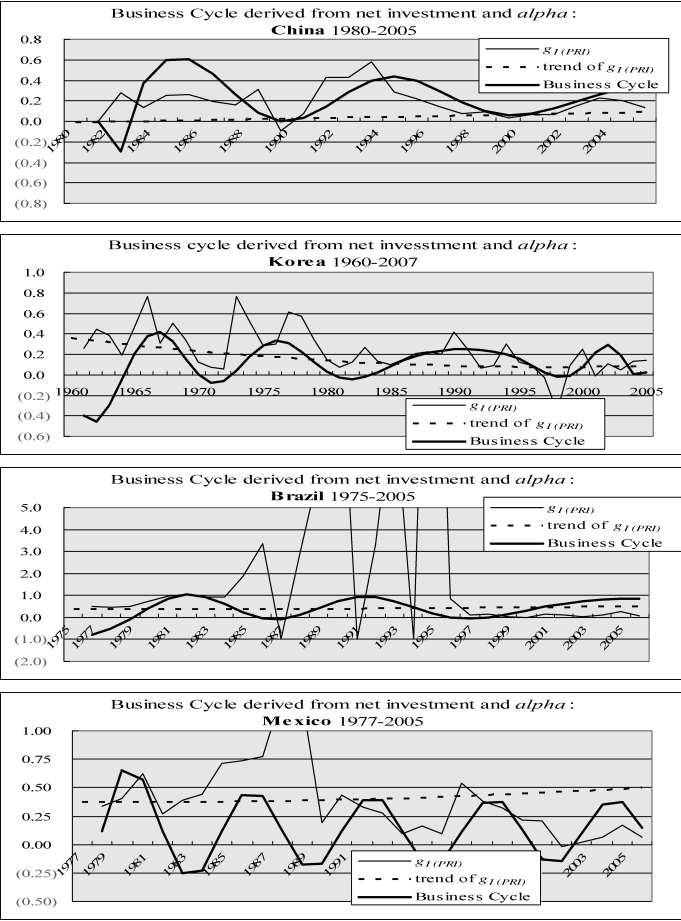


Data source: KEWT 1.07

Note: A base of cyclical trend is made of the growth rate of net investment in the private sector and the difference of the economic stage

Figure 3 Business cycle: Japan, the US, Australia, and India 1960–2005

ences should be accepted. The author adjusted exceptionally the topological at the starting point of time. Roughly, the length of each period by country does not differ much. This comes from the marching movements in the global



Data source: KEWT 1.07

Note: A base of cyclical trend is made of the growth rate of net investment in the private sector and the difference of the economic stage.

Figure 4 Business cycle: China, Korea, Brazil, and Mexico 1980/60/75/77–2005

economy. When the period of business cycle is shortened, the shape of business cycle will have a peaked cap as in Mexico, where the interest rate has been

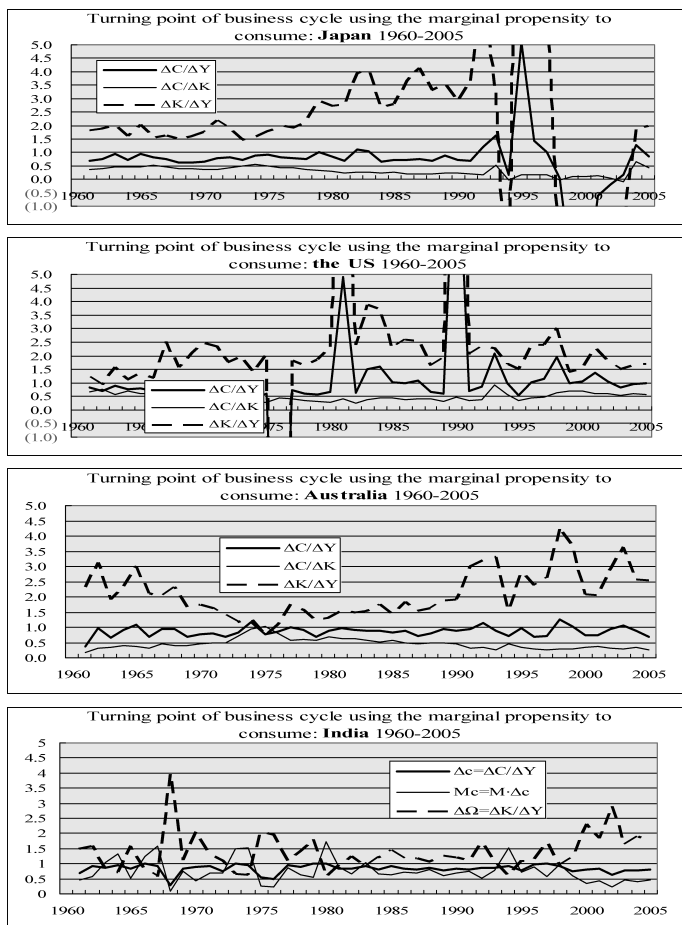
sensitively adjusted. This pattern is in a striking contrast to that in Brazil.¹¹⁾

The cause and effect analysis in business cycle

This section shows the cause and effect analysis in business cycle by country using the data-sets in KEWT. For four countries (Japan, the US, Australia, and India; each 1960–2005), Figure 5 shows the results of Eq. 2 and the capital-output ratio by sector (the total economy and the government sector). Figures 8 and 9 show the results of Eq. 7 using effective labor by sector. It is imperatively important for the smoothness of business cycle to improve technology and increase consumption or to take action to the change in the consumption multiplier. Recall that the necessary and sufficient condition to aggregate disequilibrium by fiscal year, where $\Omega > (i/n) > 0$ in the case of $\beta > 1$ or $n(1-\alpha) + i(1+n) < 0$ under $i > 0$ in the case of $\beta < 0$ (or $n(1-\alpha) + i(1+n) > 0$ under $i < 0$ in the case of $\beta < 0$) (see Appendix).

In **Figure 5**, the author compares three marginal ratios each other: the marginal propensity to consume, $\Delta C/\Delta Y$, the marginal consumption multiplier, $\Delta C/\Delta K$, and the inverse number of the marginal capital-output ratio, $\Delta K/\Delta Y$. When the marginal propensity to consume hits a ceiling several times during the 46 years, business cycle shows a turning point, together with the marginal consumption multiplier. This phenomenon is exaggerated by the marginal capital-

11) Lucas, R. E. (1975) sets up an equilibrium model of the business cycle introducing unsystematic monetary-fiscal shocks. The author agrees to the collaboration of real- and financial-assets in business cycle. This paper focuses on theoretical real-assets. The bone between two assets is the balance of payments, which is reversely expressed in financial assets. KEWT picks up, from the data of IMF, consumers' price index CPI and the interest rate of the central bank, r_{CE} , where the neutrality coefficient, $c_{CE} = r/r_{CB}$ by country surprisingly works for the long-period stability of economic growth, coping with the assets-deflation due to huge budget deficit and the assets-inflation due to super-low interest rate.



Data source: KEWT 1.07

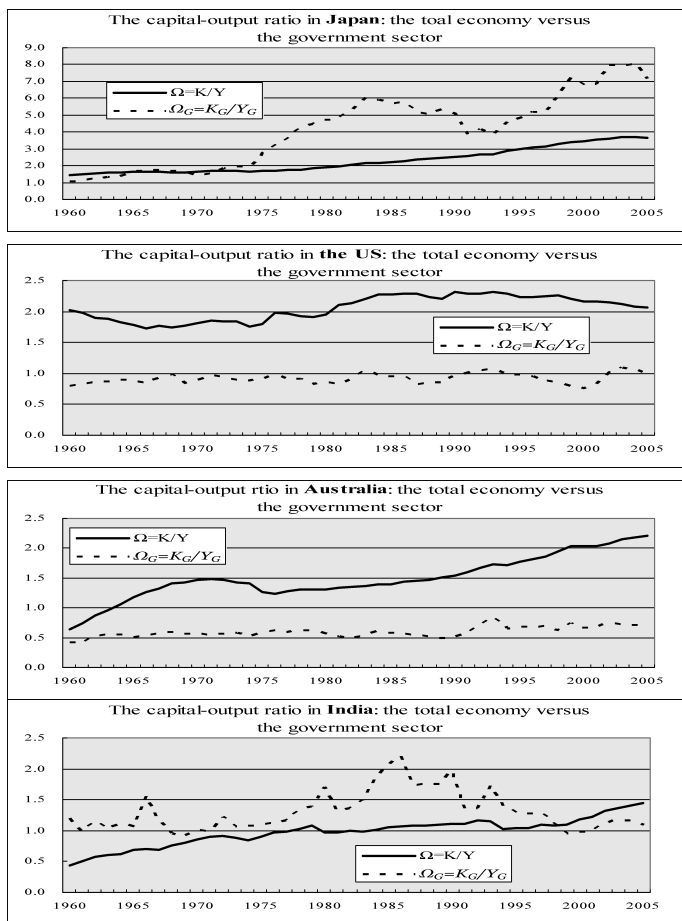
Note: Turning point of business cycle is directly shown by the marginal propensity to consume, $c = \Delta C / \Delta Y$, and accordingly, by the consumption multiplier, $Mc = \Delta C / \Delta K$, as in Jan Tinbergen (1956). These are closely related to the marginal capital-output ratio, where $\Delta c = \Delta \Omega \cdot \Delta Mc$.

Figure 5 Turning point of business cycle: Japan, the US, Australia, and India 1960–2005

output ratio or its inverse number. The marginal capital-output ratio, furthermore, qualitatively clarifies the trend of business cycle. This implies that the change in technology is sensitive to business cycle or forms the turning point of business cycle. The author stresses that if technology was given exogenously the results will be more moderate than the results given endogenously.

The above finding reflects over the capital-output ratio on average. In particular the capital-output ratio of the government sector is much sharper and higher or lower than that of the private sector and accordingly that of the total economy, as shown in **Figure 6**. The capital-output ratio of the government sector in Japan has twice formed high hills, in the 1980s and the 2000s. These hills reflect the rapid increase in national debts due to budget deficit over years. Its reason is that the rate of return of the government sector in these years had been extremely minus, which in turn had decreased government output/income. The net investment of the government sector began to decrease yet, its income decreased continuously more than net investment by year through deficit. This proves that the neutrality of national debts between generations established by Barro R. (1974) does not always hold when the ratio of qualitative investment to total investment in the government sector, β_{tG} , is significantly minus as in Japan. As a result, the capital-output ratio of the total economy in Japan has gradually increased over years. This in turn has gradually lost global competitiveness (even apart from crowding out).

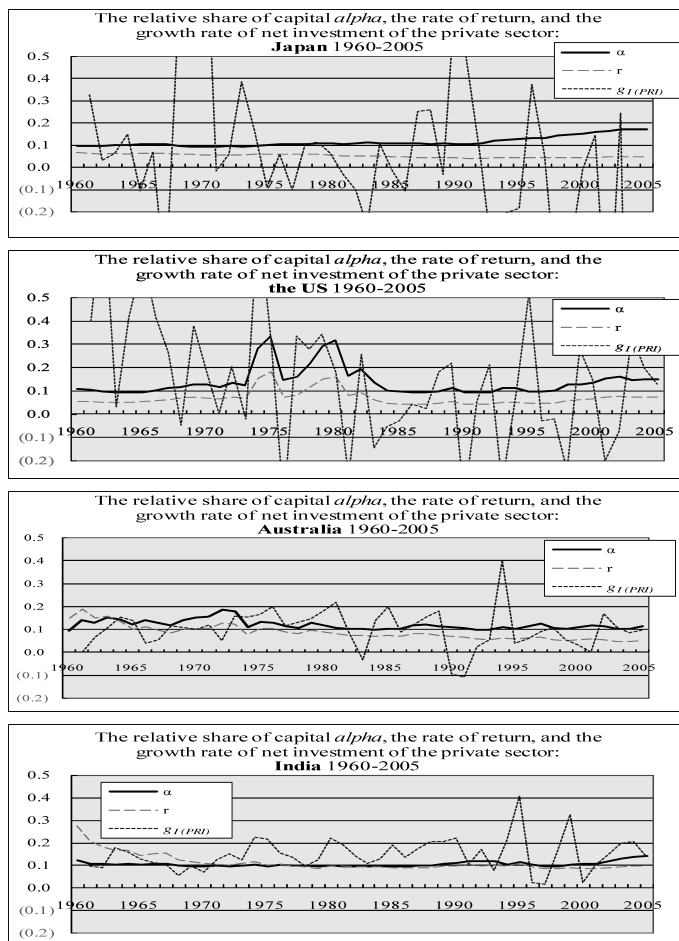
Other three countries show each a different phenomenon in that the capital-output ratio of the total economy is above that of the government sector, except for India. India had continuously suffered from inflation and deficit in the 1960s to 1990s. India, however, has changed a lot after the 2000s. The capital-output ratio of the government sector in India has increased gradually. The capital-output ratio of the total economy in India has been lower than that of the government sector.



Data source: KEWT 1.07

Note: The capital-output ratio is closely related to the multiplier through the marginal capital-output ratio (see Figure 4). Compare the capital-output ratio of the total economy with that of the government sector. The difference is most important to the transition of the economic stage.

Figure 6 The capital-output ratio by sector as a base for the economic-stage determinants: Japan, the US, Australia, and India 1960–2005



Data source: KEWT 1.07

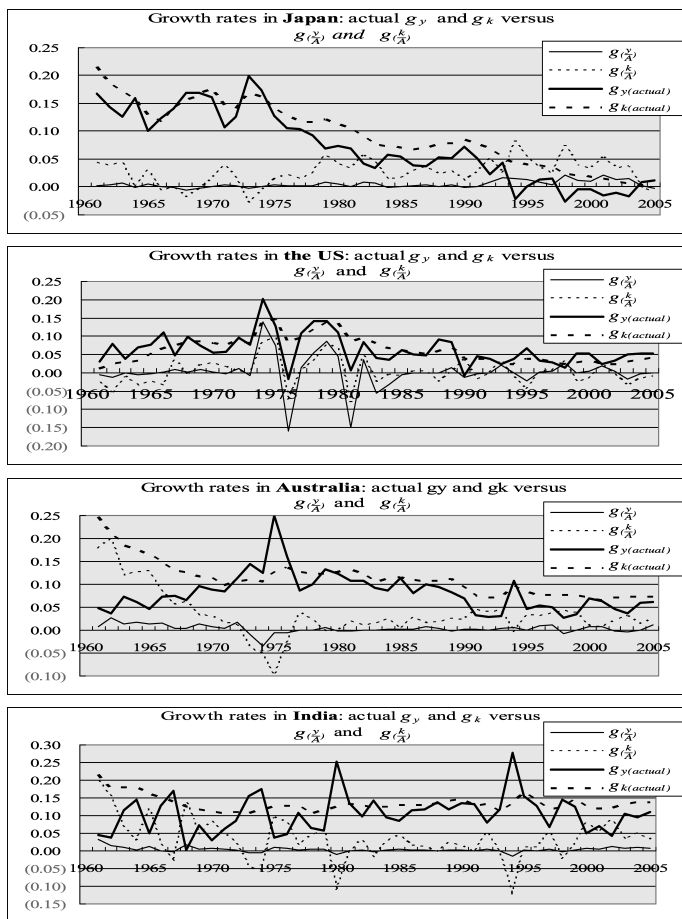
Figure 7 The relative share of capital by sector as a base for the economic-stage determinants: Japan, the US, Australia, and India 1960–2005

The US and Australia, for 46 years, have shown the capital-output ratio of the total economy considerably below that of the government sector. This phenomenon comes from ‘the policy of small government’ or ‘more democracy-ori-

ented policy.’ Japanese democracy is not based on people’s real democracy: Selfish groups and people whose priority is ‘one’s own interest’ want more from the government and this has been long realized through continuous budget deficits. Recall the crisis of democracy in deficits summarized by Buchanan, J. M. (1967, 113–125, 267–279, 280–300). The author stresses, by finding real facts by sector, that the difference of the capital-output ratio between the government and private sectors expresses a conscientious temperature of real democracy embraced by the people of an economy. The author believes that real democracy will realize a sustainable robust equilibrium by fiscal year, with a higher level of people-oriented distribution of consumption and investment. And, the author stresses that without the improvement of the multiplier, the consumption multiplier does not robustly improve.

For the above aspects, the author presents **Figure 7** indicates the trend of the relative share of capital. It is a bad sign for this ratio to rise beyond a certain level. This is because the higher the relative share of capital the weaker the marginal propensity to consume. Under the global competition, international companies, apart from the control of each government, try to increase profits and dividends in the short run, without strengthening the base of economic growth by country. Assume that the relative share of capital is constant: the lower the capital-output ratio the higher the rate of return as the natural rate of interest in the real assets.

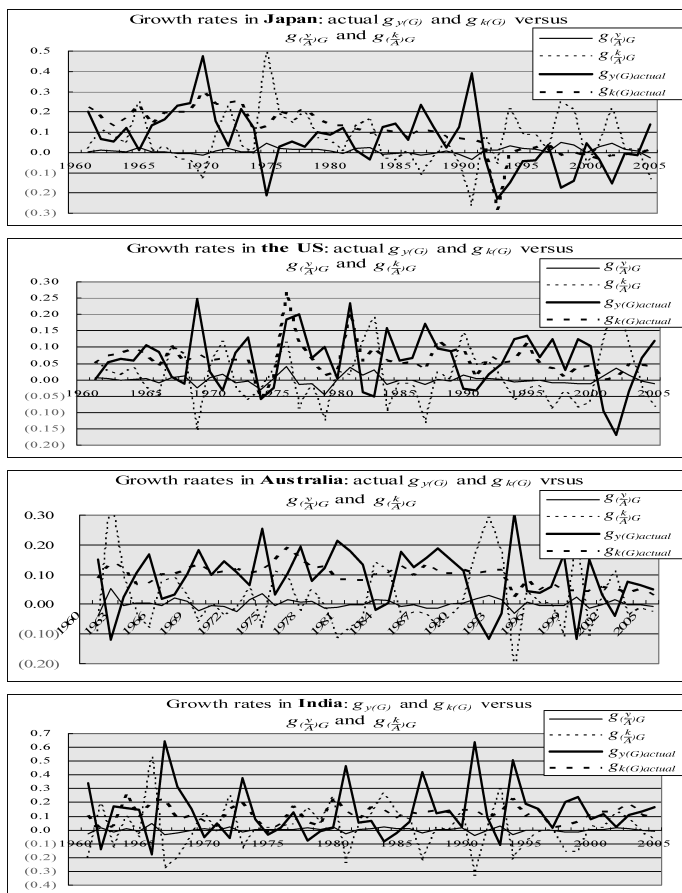
Finally, using **Figure 8** to the total economy and **Figure 9** to the government sector, the author will show the results of with/without technology in business cycle by country. The values of y and k are ‘with technology’ and, $\tilde{y} \equiv Y / \tilde{A}L$ (simply, y/A) and $\tilde{k} \equiv K / \tilde{A}L$ (simply, k/A) are ‘without technology’ (see Eq. 7). The differences of the corresponding ratios between the total economy and the government sector are significant. This implies how influential the government sector is to the total economy. The above differences almost come from those



Data source: KEWT 1.07

Note: The growth rate of capital using effective labor is in a striking contrast to the actual growth rate of capital. This implies that investment should be qualitative-oriented.

Figure 8 Comparison of growth rates of *NDI* and capital: actual growth rates versus those using effective labor: Japan, the US, Australia, and India 1960–2005



Data source: KEWT 1.07

Note: The growth rate of capital using effective labor is in a striking contrast to the actual growth rate of capital. The results for the government sector are much more violent than those for the total economy. This implies that the government share of income should be low if too quantitative.

Figure 9 Comparison of growth rates of *NDI* and capital in the government sector: actual growth rates versus those using effective labor: Japan, the US, Australia, and India 1960–2005

of the change in technology. The author finds the following facts with each implication: (1) The actual growth rate of output/income (here, actual indicates without technology) is generally very low and stable, except for the turning points of business cycle. It implies that income growth is almost equal to the change in technology. (2) The actual rate of change in the capital-labor ratio (similarly, without technology) has decreased in the long periods after 1960. It implies that the capital-labor ratio will have an upper limit when an economy becomes matured/developed or unnatural in the long periods, similarly to the capital-output ratio. (3) When technology shock is significant at the turning point of business cycle, the two (with and without) rates of change in the capital-labor ratio, $g_{(k/A)}$ and g_k , contrast (as in Japan, the US, Australia, and India) or fluctuate to the same direction (exceptionally as in the US of the 1970s and 1980s to adjust an economy after the US golden age).

The above finding is important in that technology is a shock absorber, making $g_{(k/A)}$ low and g_k high enough. This finding is wholesome and natural and, consistent with my propositions brewed in the level of the capital-output ratio. (4) Compared with the above facts of the total economy, those of the government sector much more fluctuate repeatedly and extremely. It implies that the government sector must be a shock absorber to the total economy. This is not always traced back to wrong policies but to its own function in the whole economy. In fact, the equilibrium by sector indicates that government equilibrium is most instable although this instability is usually absorbed by a robust equilibrium of the private sector (see the data-sets by country, 1990–2006). The output/income share of the government sector, however, lies between 10 to 20% by country, and this difference may accelerate the shock due to the government policies. Nevertheless, it is urgent for policy-makers to watch the results shown in Figures 9 and 10. This is because there has been no analysis as shown in Figures 7 and 8 in the literature. This suggests a progress of research

and is beyond the defense-range of the SNA.

5. Conclusions

Three economic stages were classified by the range of the theoretical capital-output ratio, whose verification is done by the consistency of the data-sets by country in KEWT, where the data-sets, once settled by fiscal year, remain principally unchanged even for forty to fifty years later. The marginal actual propensity to consume, $\Delta c \equiv \Delta C / \Delta Y$, and the marginal theoretical capita-output ratio determine the ‘sin’ patterns of business cycle, where consumption and technology work inseparably and maintain the equilibrium by fiscal year. In particular, Δc determined by the changes in actual consumption and theoretical wages differs by a country’s national taste: the marginal labor function of marginal consumption is positive in the US, Australia, China, and Russia; negative in Japan and Korea; flexible in India, Brazil, and Mexico. Budget deficit by country significantly shocks $\Delta c \equiv \Delta C / \Delta Y$, through a minus government rate of return and a minus government relative share of capital. Thus, budget deficit, as government saving less government net investment, is deeply involved in business cycle, although the literature has not revealed its numerical relationship. Also, after taking out the influence of technology, the author finds much less differences of business cycle by country.

Appendix: Endogenous variables and equilibrium and quasi-equilibrium

The data and model in the author’s data-sets finally hold as a final recursive case of the econometric approach originated by Klein Lawrence (1–12, 39–57, 1950). And, the labor/wage function of consumption as a unique behavioral equation is only manipulated in the data-sets by country and sector. All variables and three endogenous parameters are non-linearly measured by each structural/reduced non-linear equation step by step. Variables and parameters at convergence are shown with a superscript of *. These values

present foundations to economic, fiscal, and financial policies by fiscal year. For the proofs, see *PRSC* 49 (Sep), 2008.

For Endogenous variables in the discrete time

1. The ratio of quantitative investment to total investment is

$$\beta^* = \frac{\Omega^*(n(1-\alpha) + i(1+n))}{i(1-\alpha) + \Omega^* \cdot i(1+n)}. \quad (A1)$$

Eq. A1 at convergence assumes that the current/initial capital-output ratio equals the capital-output ratio at convergence: $\Omega^* = \Omega(0)$. It is possible to delete this assumption; the capital-output ratio at convergence is endogenously measured although this paper does not refer to the case of $\Omega^* \neq \Omega(0)$.

Now define; $B^* \equiv (1 - \beta^*) / \beta^*$

2. A parameter to neutralize diminishing returns to capital is

$$\delta(0) = 1 - \frac{LN(1/\Omega(0))}{LN(B^*)}. \quad (A2)$$

3. An endogenous rate of technological progress at convergence is $g_A^* = i(1 - \beta^*)$, and that by recursive years, t , in the transitional path is

$$g_A(t) = \frac{i \cdot y(t)(1 - \beta(t))}{TFP(t) \cdot k(t)^{\delta(t)}}, \quad \text{where } TFP(t) = k(t)^{1-\alpha} / \Omega(t). \quad (A3)$$

4. The discount rates of $\beta(t)$ and $\delta(t)$ in recursive are

$$\begin{aligned} r_{CONVERGE(\beta)} &= (LN(\beta^*) - LN(\beta(0))) / \text{years}_{(1/\lambda)} \quad \text{and} \\ r_{CONVERGE(\delta)} &= (LN(\alpha) - LN(\delta(0))) / \text{years}_{(1/\lambda)}, \end{aligned} \quad (A4)$$

by using $\beta(0) = \frac{\Omega(0)(n(1-\alpha)k(0)^{0-\alpha} + i(1+n))}{i(1-\alpha)k(0)^{0-\alpha} + \Omega(0) \cdot i(1+n)}$ at the current situation.

5. Speed of convergence,

$$\text{years}_{1/\lambda} = 1 / ((1-\alpha)n + (1-\delta)g_A^*) = 1/\lambda^*, \quad \text{where, } \lambda^* = \lambda \text{ at } t^*. \quad (A5)$$

$t^* = 1/\lambda^*$ is derived by setting $e^{-\lambda^* t^*} = e^{-1} \rightarrow \lambda^* t^*$, where $0.36788 = 1/2.7182818$ or $-LN(0.36788) = 1.0000$. This implies that the years for convergence, t^* , falls at convergence as an endogenous case. In the exogenous case shown in the literature, the years for convergence are infinite so that a half way of the difference of the capital-labor ratio calculated between the current situation and at convergence is taken into consideration. Endogenously, $t^* = 1/\lambda^*$ is fully justified while exogenously $t^* = \infty$ has a problem for measure.

6. Technology-golden rule between the rate of return and the growth rate of output at convergence is

$$r^* = \left(\frac{\alpha}{i \cdot \beta_{\delta=\alpha}^*} \right) \cdot g_Y^* \quad \text{by using} \quad g_Y^* = \frac{g_A^*(1+n)}{(1-\alpha)} + n \quad \text{and}$$

$$r^* \equiv \frac{\alpha}{\Omega^*} = \alpha \left(\frac{i(1-\beta^*)(1+n) + n(1-\alpha)}{\beta^* \cdot i(1-\alpha)} \right). \quad (\text{A6})$$

7. The valuation ratio,

$$v_K \equiv V / K, \quad v_K \equiv \frac{r^*}{r^* - g_Y^*} \quad \text{or} \quad v_K = \frac{\alpha}{\alpha - i \cdot \beta^*}, \quad \text{where} \quad (\text{A7})$$

the cost of capital is shown as $r^* - g_Y^*$ at convergence. This cost is compared with the central bank interest rate or the market rate. This cost and the rate of return are useful to examine the neutrality of financial assets. Policy-makers must be alert at changes in these several data by fiscal year.

For Aggregate equilibrium and quasi-equilibrium

The literature does not show the necessary and sufficient conditions (if and only if) of aggregate equilibrium by fiscal year. These conditions are only proved endogenously. ‘Endogenously’ here implies that hidden three parameters (*beta*, *delta*, and *lambda*) in the Cobb-Douglas production function and derived variables are all endogenously measured. For instance, education and R & D may produce an endogenous rate of technological progress. Yet, this is not an endogenous growth model in a strict sense, according to the author’s interpretation. Disequilibrium happens at the government sector. One of reasons is that the government sector is out of competition and that politicians want current votes rather than the insight of future generations. Equilibrium and quasi-equilibrium are closely related to business cycle of the private sector. This is because the government sector influences the private sector significantly. Business cycle occurs when equilibrium is required by the changes in net investment and consumption. If an economy fails in equilibrium, the model does not work, falling into disequilibrium or quasi-disequilibrium. Given the growth rate of population, the ratio of net investment to output greatly influences equilibrium by fiscal year.

8. For $\beta^* > 1$, disequilibrium holds if and only if

$$\Omega > (i/n) > 0 \quad (\text{related to A1 to A4}). \quad (\text{A8})$$

The growth rate of population, n , influences equilibrium delicately. The test prefers $n = 0.0001$ to $n = 0$ to avoid $i/n = 0$.

9. For $\beta^* < 0$, disequilibrium holds if and only if

$$\begin{aligned} n(1-\alpha) + i(1+n) &< 0 \quad \text{under } i > 0 \quad \text{or if and only if} \\ n(1-\alpha) + i(1+n) &> 0 \quad \text{under } i < 0. \end{aligned} \quad (\text{A9})$$

Quasi-equilibrium is defined as the situation of $\lambda^* < 0$.

10. Quasi-disequilibrium holds if and only if

$$\begin{aligned} (1+n(1-\alpha)/(i(1-\beta^*))) &< \delta_0 \quad \text{under } i > 0 \quad \text{or} \\ (1+n(1-\alpha)/(i(1-\beta^*))) &> \delta_0 \quad \text{under } i < 0. \end{aligned} \quad (\text{A10})$$

ビジネス・サイクルの内生化視覚 (Perspectives of endogenous business cycles)

今日までのビジネス・サイクル論は、著者の完全に内生的モデルの立場からみると (see Kamiryo, *PRSC* 49 (Sep) 2008), 理論・歴史・政策のすべての側面にわたって、外生的である。内生ビジネス・サイクル論は、年度毎のマクロ均衡を不安定にする要因を簡潔に内生的に示す点に、その特色がある。ここに、マクロ均衡は、国ごとの実物資産における数個の所与値と数十の内生パラメータと変数によって確保されている。文献では、Zarnowitz, Victor. (1996) の長期比較に示されるように、金融資産による攪拌も無視できないが、基盤は実物資産にあり、ビジネス・サイクルが起きる起因は、実物資産に十分に示される。短期には、金融資産の乱高下に目を奪われても、長期には、実物資産こそ、一国の経済にすべての責任を負う。実物資産と金融資産との関係については、別稿に予定している。

上記の数個の所与値とは、GDP, 国際収支, 財政収支, 政府消費と民間消費, 人口である。これらから理論的可処分所得, 理論的純投資, 理論的貯蓄, 理論的 (内生) 資本, 理論的雇用者報酬, 理論的利潤 (政府および民間別) が算出される。したがって、外生的パラメータ (人口成長率), 内生的パラメータ (内生モデルを支える β , δ , λ を中心に、対理論的可処分所得の投資率, 消費率, 貯蓄率をはじめとして、対理論的可処分所得の理論的雇用者報酬, 理論的利潤ならびに理論的資本・産出比率, 対理論的資本利潤率), そして、技術進歩率をはじめとするすべての内生的変数が算出される。理論的とは、実際値と区別され、全体系における内生的な測定を意味する。

年度毎のマクロ均衡は、年々の生産物需給均衡によって維持される。しかし、そのレベルは、年々その質を異にする。最適の範囲としてのレベルの質は、ことに投資率と消費率の変動幅に反映される。年ごとの対理論的可処分所得の純投資率 (以下、投資率) は、マクロ不均衡突発の可能性に強く関与する。マクロ不均衡が起きるとすれば、その条件は、まず $\beta > 1.0$ であり、 $\beta > 1.0$ は、 $n \cdot \Omega > i$ に置き換えられる。たとえば、人口成長率が 1%, 資本・産出比率が 4 であると、投資率は、4% 以下でないと、不均衡に陥る。また、準不均衡は、収束不能 (収束年数がマイナスか異常に長い場合) であるが、その最大の原因は投資率の政府部門と民間部門への異常なアンバランスである (日本は 58 カ国中、政府部門投資率の過大さにおいて、格別に異常)。政府部門と民間部門へのバランスある投資率こそ、収束年数を正常の範囲内に引き戻す。その意味において、投資率は、均衡・不均衡・準不均衡への鍵を握る。投資には、環境対応投資を決して別枠にできない。

ビジネス・サイクルは、民間部門の均衡への緊急避難ショックとして、定義できる。しかし、そのようなビジネス・サイクルは、政府部門の政策によって著しく左右される。政府部門のシェアはまず 10 - 25% に過ぎないとしても、ビジネス・サイクルをきわめておだやかにするか、はげしく変動させるかは、政府部門の政策 (財政赤字と政府投資率) のいかに依存しやすい。その意味において、ビジネス・サイクルは、実物資産をベースにした内生的所産である。

政府部門利潤率は、すり鉢のようににはげしい累積財政赤字に一旦落ち込むと、たちまちマイナス 10% を越えやすい。そこでは、相当量の資金供給 (M2, Money plus quasi-money) がないかぎり、その損失によって失われたマネーを正常レベルまで回復しにくい。つまり、デフレを克服できない。その構造は、内生・部門別モデルにおいてのみ、証明可能である。そこでは、本来補完に徹すべき金融資産が表舞台に踊り出る。そのマネーは、均衡を積極的に回復させ得るわけではない。ビジネス・サイクルにショックを与えることは、事実である。それゆえに、文献では、金融資産の変動にウエイトをおく実際データの実証も多くみられる。それらはあくまで短期的補完にとどまると、著者は考えている。ビジネス・サイクルの本質は、実物資産の緊急的な均衡回復過程におけるショックの生起と解してよい。ビジネス・サイクルの本質は、内生的においてのみ、克服され得る。著者のいう完全内生モデルがデータと整合的に共存する場合においてのみ、ビジネス・サイクルの本質は、測定され、政策的に解明されるのである。内生モデル内では、価格水準 p は、移行過程を通して、1.0 にとどまる。インフレーション・レートは、金融資産とマーケットの外生値を通して確認されるため、ビジネス・サイクルには補完的である。

本論文は、the data-sets KEWT 1.07, 1960–2005 を使用している。しかし、その解釈は、その後の KEWT 2.08 を踏まえている。その概要は、次のように纏められる。

民間部門の投資率は、国際収支、財政赤字からの影響を踏まえた実物経済成長への起爆剤である。本論文は、John Hicks (1950) の \sin 式に基づく国別実証を、内生データに基づいて明らかにしている。Hicks の \sin 式は、その後の文献に実証されていない。のみならず、文献におけるビジネス・サイクルのすべての実証は、今日まで、実際データによるトレースがすべてである。実際データを理論的データに置き換える方法論が存在してこなかったのであるから、理論的データによる実証が存在しないのは当然である。Econometrics による解析は、ビジネス・サイクルにも勿論向けられてきた。しかし、econometrics による解析に使用されるデータは、実際データと弾力性値の見積もり、それを受けての相関係数による判断がベースにあり、決して理論にしたがってはいない。

それに対して、本論文のビジネス・サイクル実証は、データと内生モデルの統合のもとに、すべて理論的である。投資率は、技術進歩率と式の上では区別されるが、技術進歩率自体が投資率と一体不可分である。もしその技術進歩率がゼロと仮定した場合には、ビジネス・サイクルはどうなるのであろうか。この疑問に対して、本論文は、補足的に実証を示す。その結果は、ビジネス・サイクルをきわめて滑らかにする。それでも、ビジネス・サイクルらしきものは存在する。なぜであるのか？ ビジネス・サイクル形成へのショックは、最終的に、限界消費率の緊急的なショックとして収拾されるためである。ここに、消費率は、投資率や技術進歩率とタイトに結びついている。本論文にあげる式は、それらの関係を示す式が核になっている所以である。

それらの式の初出は、Jan Tinbergen (1956) の消費と資本とを直結する試みにみることができる。Tinbergen は、資本・産出比率をベースに消費との関係を示すケース

を示す。ただし、その資本・産出比率は、実証によって裏付けられてはいない。当時は、国民経済計算システムが揺籃期にあり、資本はミクロにベースを置く恒久的棚卸法 perpetual inventory method によって見積もられるほかなく、その手法は、マーケット・データに依存して企業部門のみを対象にした方法（Paul Schreyer, 2004 ほか）を別にすれば、今日まで変わらない。ここに、もう一つの難関（ミクロ・ベースの消費をマクロの理論的消費）が重なり、消費・資本比率に関する実証は、econometrics に依存せざるを得ず、今日まで、部分的かつ実際データの数に応じた結果をみせているにとどまる。

KEWT 1.07 および 2.08 は、国別に上記の諸点を克服している。それらは、財政年度毎にとられた政策（economic, fiscal, and financial）の plan, do, see が完結できるシステムとして機能している。国の政策は、国民性や national taste に応じて、それぞれ異なる。しかも、今日の世界はグローバル社会である。ことに、金融資産は、国を越えて、グローバル化し、バブルを10年に一度引き起こし、急激な損失発生は、直ちにそれを緩和するマネーの供給を必然的とする。それにもかかわらず、マネーの供給は損失によってすでに消費されており、実物資産の健全な回復には役に立たない。ここに、実物資産をベースにした回復は、内生モデルによってのみ保証される。その要は、各国が上にあげた消費率に結果する投資率と技術進歩率に向けた、そして、収束時点を展望した均衡への政策を協調的にすすめる努力をにおいて存在しない。ビジネス・サイクルのショックは、内生的政策協調のもとに、金融資産に対する制約（金利平価、為替平価の一定の順守）が避けられないとしても、相当にゆるやかなものに収まるはずである。本論文では、省略しているが、KEWT 1.07 のグラフ編では、過去（1960–2005）における国別ビジネス・サイクルに関連して、詳細なグラフを数多く掲載している（PRSCE 48 (sep), 2007c）。

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