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Capital Stock and its Rate of Return by Sector, Actual Versus Endogenous:
Japan and the US, 1960-2010

Hideyuki Kamiryo

For additional information please contact:
Name: Hideyuki Kamiryo
Affiliation: Hiroshima Shudo University
Email Address: kamiryo@ms3.megaegg.ne.jp

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Abstract

This paper examines endogenous capital stock and its rate of return at the author’s database, KEWT 6.12-6, 1960-2010, comparing endogenous data with actual data in statistics and extending the range of consistency to structural ratios such as the relative share of capital, the capital-output ratio, and the rate of return in the endogenous-equilibrium. It is proved that capital stock, its rate of return, and all the parameter and variables completely satisfy a whole consistency by sector (the total economy, the government and private sectors), over years and just before the redistribution of taxes and deficit to final income. The author clarifies definite differences lying between the current databases obeying accounting and market principles and KEWT database in the endogenous-equilibrium.

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1. Introduction: capital stock, actual versus endogenous

This paper clarifies how essential for policy-makers to endogenously measure capital stock and its rate of return in equilibrium and compare endogenous data with corresponding actual statistics data. In the literature, actual/estimated capital-related data are available in statistics such as Penn World Table (PWT, and EPWT, see below soon) and OECD national accounts data (http://OECD.com and Paul.Schreyer@OECD.org), in addition to annual national accounts by country (UN: http://unstats.un.org/unsd/snaama/selectionbasicFact.asp). See, for example, Bureau of Economic Analysis (BEA), Dept of Commerce, the US (http://www.bea.gov) and, Annual Report on National Accounts, Cabinet Office, Japan (http://www.esri.cao.go.jp/). However, there is no purely endogenous capital stock except for the capital stock measured by KEWT series of data-sets. ‘Purely endogenous’ here means that capital stock is measured completely within a policy-oriented system and without using accounting method such as Perpetual Inventory Method (PIM) and/or financial market data such as the cost of capital at the stock markets. Capital stock in the literature is estimated using econometrics-methodology solely at the private/corporate sector, where the total economy is another expression of the private sector. Capital stock in the literature is based on a system of national accounts (SNA, 1993) that aims at records or recording and accordingly, uses final income after redistribution of taxes and deficit by fiscal year. Estimated results hold at the price-equilibrium involved in static ‘general equilibrium’ and under an assumption of perfect competition. Thus, there is no return or profit at the government sector. Or, there is no capital stock that is completely consistent with the rate of return by sector. Or, the rate of return and the growth rate of output each are the object of a dependent variable in econometrics. In short, theoretical consistency in the literature, to the author’s understandin, holds with econometrics-methodology that differently applies a variety of parameters to each model and uses given statistics and other any data.

There is no capital stock data by country and by sector that are consistent with all the other data by year and over years, except for KEWT 6.12 (http://riece.tv). KEWT 6.12 measures all the parameters and variables for 81 countries, 1990-2010 (i.e., short periods) and 1960-2010 (i.e., long periods), within its system. KEWT 6.12 obtains 25 original data, 10 from real assets and 15 from financial/market assets, thanks to International financial Statistics yearbook, IFSY, IMF. IFSY, IMF (http://imf.org) and the World Bank (http://data.worldbank.org) most widely and consistently publish consecutive data. It may be next to impossible for IFSY to consistently publish capital stock. It is a surprising challenge for BEA to publish the estimation of capital stock in its Survey
of Current Business.

Penn World Table (PWT 6.1, after 5.6, 1950-1995) had bravely stopped the publication of the capital-labor ratio after 1996 by a few reasons, as the author researched and discussed earlier (see JES 12 (Feb): 59-104). Today, Extended Penn World Table (EPWT) v.4.0 publishes 31 items for 166 countries, 1963-2009. This database is available with the current PWT 7.0. EPWT v.4.0 (http://www.pwt.econ.upenn.edu) shows ‘nine’ items related to capital stock, from item 11. to 19. For example, look at item 15; the capital-labor ratio in 2005 purchasing power parity. Readers soon realize that the capital-labor ratio is a base for estimating capital stock. The literature has used the capital-labor ratio as a base for the framework of each model, incidentally without interrupted by the capital-output ratio. This is natural from a fact that the individual utility function has historically connected maximized consumption per capita as a goal and that economic growth has been a means to the goal. Labor and capital are two masters at the Cobb-Douglas production function. Besides, markets are independently vertical by market, e.g., capital, labor, financial, stock, and many others, each tied up with its price level in the general equilibrium theoretically proved by Arrow, K.J. and Debreu, G. (1954).

Among 31 items selected at the EPWT v.4.0, the rate of returns is not included. The author at once realizes that any item selected is not divided into sectors. The author stresses that the equality of national income, expenditures, and output is proved only when taxes and deficit are realized at once. The capital stock and its rate of return match in equilibrium and theoretically proved by Arrow, K.J. and Debreu, G. (1954). Each endogenous parameter control endogenous data at the KEWT data-sets. This comparison constitutes an aspect. Other papers focus on other aspects such as robustness of an economy, economic stages, national taste/preferences and culture, fiscal multipliers, business cycles, stop-macro inequality, and the rate of change in population and the rate of technological progress. Some of these aspects overlap by nature. Each fundamental background is common to any aspect. This is because endogenous equations exist behind and under the endogenous-equilibrium. Also, this paper steps into a version of ten hyperbola equations that are obtained by reducing each endogenous equation. Note that each endogenous equation or its hyperbola is non-linear in the discrete time.

The endogenous system integrates theory and practice at KEWT itself. The theory starts with the discrete Cobb-Douglas (C-D) production function under constant returns to scale. The discrete C-D production function reveals seven endogenous parameters and produces endogenous equations consistently as many as policy-makers want. Seven endogenous parameters control KEWT data-sets by country. Endogenous equations are each reduced to hyperbola. Each hyperbola is composed of four elements. Each hyperbola is expressed as a function of a dependent variable to an independent variable, assuming that other elements are constant. Each hyperbola has the vertical and/or horizontal asymptotes (VA and/or HA) to determine the upper or
lower limit of dependent and/or independent variables. Without these VA and/or HA, each endogenous equation cannot obtain its optimum range of the two variables, dependent and independent.

For example, the hyperbola of the rate of return, \( r^* = \Pi / K \), to the ratio of net investment to output, \( i = I / Y \), is expressed by \( r^*(i) \); for the first appearance, see PRSCE 51 (Feb): 61-103. Standard form of the hyperbola is shown by \( y = \frac{cx+d}{ax+b} \) or \( (y - \frac{c}{a}) (x + \frac{b}{a}) = \frac{f}{a} \), where \( f = d - \frac{bc}{a} \), \( VA = -\frac{b}{a} \), and \( HA = -\frac{c}{a} \). The standard form has four elements, a, b, c, and d. When one or two of four elements are zero, standard form is reduced. Each form is called a type. Six types exist by function: if \( a=0 \), \( y = \frac{cx+d}{b} \); if \( b=0 \), \( y = \frac{cx+d}{ax} \); if \( c=0 \), \( y = \frac{d}{ax+b} \); if \( d=0 \), \( y = \frac{cx}{ax+b} \); if \( c=d=0 \), \( y = \frac{1}{ax+b} \). And, if a, b, c, and d each are not zero, back to standard form, \( y = \frac{cx+d}{ax+b} \).

Let the author clarify the relationship between ten fundamental hyperbolas and six types. Independent variables are strictly limited to two items, \( i = I / Y \) and, the rate of change in population, \( n_E = n \), where \( n_E \) is the rate of change in population and, \( n \) is the actual growth rate of population. Ten fundamental hyperbolas are attributed to six types by function as follows:

\[
y = \frac{cx+d}{ax}, \text{ b=0 and } VA=0:
\]

1). \( r^*(i) \), where \( r^*(i) \) guarantees a maximized rate of return with a minimized net investment in a moderate endogenous-equilibrium. Also, the rates of inflation/deflation are determined by \( r^* = HA r^*(i) \).

2). \( \beta^*(i) \) or \( \bar{\beta}^*(i) \), where \( \beta^* \) is the quantitative net investment coefficient and \( \bar{\beta}^* = 1 - \beta^* \) is the qualitative net investment coefficient. This hyperbola presents an endogenous base for the rate of technological progress, \( g_A^t = i(1 - \beta^*) \).

3). \( \Omega^*(\beta^*) \), where \( \Omega^* \) is the capital-output ratio, \( \Omega = K / Y \) (in detail, see below soon). \( \Omega^*(\bar{\beta}^*) \) shows the relationship between technology and capital stock and is another expression of \( \Omega^*(\beta^*) \).

\[
y = \frac{cx+d}{b}, \text{ a=0 and } VA=0:
\]

4). \( r^*(n) \), where the relationship between the rate of change in population or the increase/decrease in actual population and the rate of return is shown (for the use, see note 1).

\[1\] Let the author define that the rate of unemployment is zero at \( n_E = n \). It implies that if the actual growth rate of population equals the rate of change in population in equilibrium, there exists no unemployment. KEWT 6.12, 1990-2010, satisfies this condition always in a moderate range of equilibrium. KEWT 5.11, 1990-2009, allowed the rate of unemployment to be the last means for maintaining a moderate range of equilibrium, where an endogenous NAIRU (a non-accelerated-inflation rate of unemployment) endogenously exists. KEWT 5.11 is convenient for policy-makers to draw a hyperbola of \( r^*(n_E) \) and prove the existence of the endogenous NAIRU while KEWT 6.12 cannot draw the hyperbola of \( r^*(n_E) \) due to \( n_E - n = 0 \).
\[ y = \frac{1}{ax + b}, \quad c=0 \text{ and } d=1, \text{ and thus, } HA=0; \]

5). \textit{speed}(i), where the speed years for convergence by country is shown by \(1/\lambda^*\) and \(\lambda^* = (1 - \alpha)n + (1 - \delta_0)\). \(\alpha\) is the relative share of capital, fixed by year, similarly to \(i = 1/Y\) and \(n_E = n\). \(\delta_0 = 1 + (LN(\beta^*)/LN((1 - \beta^*)/\beta^*))\) is the diminishing and increasing returns coefficient, and \(\Omega = \Omega^* = \Omega_0\) is the capital-output ratio, similarly to \(r = r^* = r_0\). Note, \(\alpha = r^* \cdot \Omega^*\) constitute a core of the structural ratio.

6). \textit{speed}(n). This hyperbola answers a variety of results obtained by using the current methodology of econometrics towards the relationship between equilibrium and the increase/decrease in actual population.

\[ y = \frac{cx}{ax + b}, \]

7). \(\Omega^*(i)\), where net investment and the capital-output ratio are examined.

8). \(i(n)\), where labor and net investment are examined.

9). \(\Omega^*(\beta^*)\), where quantitative net investment coefficient and the capital-output ratio are examined.

\[ y = \frac{d}{ax + b}, \]

10). \(\Omega^*(n)\), where labor and capital are examined.

\[ y = \frac{cx+d}{ax+b}, \quad VA = \frac{-b}{a} \text{ and } HA = -\frac{c}{a}. \]

11). \(\beta^*(n)\) or \(\bar{\beta}^*(n)\), where even if \(n_E = n\), this hyperbola presents the relationship between the qualitative net investment coefficient and the increase/decrease in actual population.

12). \(\alpha(i)\). This hyperbola determines an optimum range of stop-macro inequality to net investment.

13). \(\alpha(n)\). This hyperbola determines stop-macro inequality and the increase/decrease in actual population.

Note, \(\alpha = r^* \cdot \Omega^*\) is a keystone of policy-making and also, if \(a=0\) and \(b=0\) happen at the same time, there exists no hyperbola. The above types are examined by type and also by combination of a few related aspects.

In short, the above hyperbolas wholly answer various aspects’ results estimated and hypotheses proposed by using econometrics in the literature. These hyperbolas, in the case of abnormal or unbalanced, spread from the 1st quadrant to the 2nd or 4th quadrant and may swing between space and time. Seven endogenous parameters are differently expressed by four elements, \(a, b, c,\) and \(d\) in \(y = (cx + d)/(ax + b)\). Using four elements, \(a, b, c,\) and \(d\), endogenous data are all expressed. But, seven endogenous parameters control the discrete C-D
production function dynamically by year and over years, supported by four elements that determine upper or lower limit of variables. These hyperbolas are drawn using Tomoda Katsuhiisa’s software. His graphic software has completed as his life-work for mathematical education goal at schools in Japan. Hyperbola graphs are drawn by type, country, and year and, available by request.

2. Capital stock and the difference between actual and endogenous: Japan and the US

This section examines the trends of capital stock; actual and endogenous, using Figures 1 to 3 for Japan and Figures 4 to 6 for the US, each 51 years, 1960-2010, and supplementing these trends with such ratios as growth rates and the rate of return. Figure 1 for Japan and Figure 4 for the US each show 1) GDP and NDI, actual and endogenous, 2) capital stock, actual and endogenous, 3) actual net investment and 4) endogenous net investment, by sector (the total economy, the government sector, and the private sector). Figure 2 for Japan and Figure 5 for the US each show 1) growth rates, actual and endogenous, 2) the capital-output ratio, actual and endogenous, 3) the rate of return, actual and endogenous, and 4) the relative share of capital, actual and endogenous. And, Figure 3 for Japan and Figure 6 for the US each show 1) ‘actual less endogenous’ net investment to output, by sector, 2) actual, endogenous, and ‘actual less endogenous,’ taxes to output, 3) the balance of payments, deficit, and ‘saving less net investment’ at the private sector, and 4) taxes less deficit, subsidies, depreciation, and ‘net investment divided by gross investment.’

The differences between actual and endogenous ratios in Japan are not so much as those in the US. On the contrary, ‘actual less endogenous’ capital stock in the US is striking. Actual capital stock is two times as large as endogenous capital stock in the US. Why does this happen in the case of the US? First, two growth rates of GDP output and endogenous output Y are steadily high by year, partly supported by the actual growth rate of population. Second, the Bureau of Economic Analysis (BEA), Dept of commerce, publishes Survey of Current Business monthly, but its data are estimated using the accounting method such as Perpetual Inventory Method (PIM) and vintage and, the market data such as the market cost of capital. It implies that BEA’s work is the next to its limitation and still challenges its consistency consecutively. As a result, discrepancies of statistics are indispensable by year. The BEA must adjust the discrepancies so as to be smaller. These discrepancies, in fact, have been analyzed over years.2 For comparison, the author here raises the contents of Survey of Current Business: National Data are composed of selected NIPA tables, NIPA-related tables, Historical measures, Charts, Industry Data, International Data (Transactions tables, Investment tables, and Charts), with Regional Data. The system-oriented idea and presentations conceived by Survey of Current Business are similar to those confirmed at KEWT or the endogenous system. Note, each approach has its own, statistics versus purely endogenous.

Back to capital stock, what does a fact imply that actual capital stock is extremely higher than

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endogenous capital stock in the US? Net investment has been robustly moderate in the US, while in Japan net investment has typically shown long prosperity and decay, from a developing to developed stage, for the last 51 years. A unique reason comes from the difference of the deficit to GDP or Y, except for after 2008 (for proofs, see a separate paper). As a result, net investment is steadily higher in the US than that in Japan. Also, ‘actual less endogenous’ of net investment is normal in the US. Actual capital stock increases steadily in the US, solely due to a steady level of net investment by year and over years. A higher level of capital stock is not caused by the differences of statistics-methodology but by a higher level of actual net investment than that in Japan.

As a result, structural ratios such as \( \alpha = r^* \cdot \Omega^* \) has been normal in the US while structural ratios has been abnormal in Japan, particularly after the 1990s when government saving turned to minus. Actual and endogenous net investments have shrunken after the 1990s in Japan. This shows so called the private sector’s ‘crowded out’ by the government sector. ‘Crowded out’ never stops when deficit by year accumulates consecutively. The endogenous rate of return approaches to zero. This fact remains an expression of aggravated real assets. It seems that the central bank may lead zero interest rate in order to lower ten year debt yield but, it is completely an illusion. It implies that the central bank must be neutral to politics and watch economies under a stable price level. This neutrality has been shown by leaning by doing, over centuries historically.

Capital stock in KEWT series is simultaneously measured with all the other parameters and variables by year. This paper needs to test whether the level of consistency differs or not between long periods and short periods selected in each data-sets. For the difference of selected periods, the author compares KEWT 6.12-6 for 1960-2010 (long periods; 51 years) with KEWT 6.12-1 for 1990-2010 (short periods; 21 years). Conclusively speaking, the author admits a slight difference of the level of consistency: The longer the periods the more stable an economy is. Also, the closer the periods to the current year, the whole system becomes more dynamic and focuses the current integrated policies. The discrepancy of consistency appears at capital stock and the capital-output ratio but negligible enough, particularly in Japan.

The above discrepancy is examined by comparing policy-oriented structural ratios at the US. Figures 8-1 and 8-2 show the results of long periods (1960-2010), where the level of consistency spreads over 51 years. Figures 9-1 and 9-2 each similarly show the result of long periods, but the 1990 data are set the same as the initial data in 1990 at short periods. The same initialization setting in 1990 influence the results and expresses some adjustments over years.

Remember: KEWT data-sets have no initialization problem. This is because the initialization at a starting year has no given data. KEWT calculates all the data even at the starting year and, stop tautology and avoid falling into circulation. In this respect, KEWT differs from those databases that use flows for Log-growth, at Real-Time, and in the continuous time and, that use a residual approach in the discrete time to total productivity factor (TFP) and/or labor.

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productivity by New Keynesian model.

KEWT solves a problem of the initialization typically using capital stock. Tentatively at first, KEWT designer inserts a value of capital stock at the starting year. This value is inappropriate or causes an inconsistency among all the parameters and variables over years. This value must be replaced by a fitted value, repeating experiments; perhaps hundred times until all the values and ratios are consistent over 21 or 51 years. As a result, the current KEWT 6.12 series, long periods and short periods, have completed today, leading any discrepancy to zero. For extending structural ratios, see Figures 10 and 11 at the end. These two figures are useful to wider comparisons between Japan and the US. These are discussed in detail in a separate paper.

3. Databases facing at problems lying between Keynesians and Neo-classicists

This section first confirms the fundamental difference lying between Keynesians and Neo-classicists and second, summarizes characteristics of the current databases tied up with Keynesians and Neo-classicists.

First, the fundamental difference between Keynesians and Neo-classicists is whether or not inventory investment is included in total investment. Neo- and New-Keynesians includes inventory investment in total investment while Neo-classicists exclude inventory investment from total investment. Uzawa, H. (231-232, 1989) uniquely pointed out the contradiction of the above fundamental difference. The cause behind is traced back to the principle of equivalent at the SNA to three aspects of income, expenditures, and output. The literature, however, has not constructed a corroborative system for the principle of equivalent, since Meade (1961) and Meade and Stone (1967) first clarified its conceptual framework.

The endogenous system follows Neo-classicist standpoint that sets physical investment as total investment and, measures the output under the principle of equivalent, wholly consistently as a system (i.e., avoiding partial estimations). The principle of equivalent is only measured when wages and returns are measured at the real assets, apart from the macro supply and demand curve framework under the price-equilibrium. Only when saving less investment is zero by sector, total economy returns equal the returns at the private sector. This result comes from the relationship between the balance of payments, deficit, and the difference of saving and investment at the private sector. The SNA sets its own goal recording, where wages are attributed to households and returns to enterprises and corporations after the final redistribution. Statisticians must respect the function of recording at an original actual statistics system.

Second, this section summarizes characteristics of the current databases common to Keynesians and Neo-classicists. There has existed no database to connect the rate of return with the growth rate of output in equilibrium, except for the endogenous system. Likewise, there is no database wholly to connect specified national taste with technology or, deeply to connect micro utility with macro aggregated utility in globalization, except for the endogenous system. The current databases follow the current economics, based on an assumption that micro data are essential to macro aggregation, and without a perspective to solve a utility problem lying between macro and micro. Is there any breakthrough to get rid of the above fixed concepts? Review two
facts: (i) Micro utilities have not established a precise method to measure utility as a whole. (ii) It is mandatory for micro followers to pursue consumers’ goal by maximizing consumption per capita. As a result, micro followers do not connect utility with technology. Endogenously, define ‘national taste’ as an equation totally designed to preferences, culture, nationality, and history, by country. Then, macro aggregated utility is connected with technology as growth engine.

It is true to some extent that technology is independent of national taste but, technology and national taste are united within the endogenous system wholly as a system. Therefore, national personality and globalization coexist naturally without contradiction, by country, by year and, over years. An economy never repeats the same pattern or phenomenon over years, as we have experienced historically in this world. The author interprets these results in the endogenous-equilibrium such that the rules are derived definitely but results differ by the idea and philosophy of leaders and policy-makers and also by the integrated policies of real, financial, market, and central bank; by country or common area.

Therefore, an internal rate of return at Keynesian databases has been estimated independently from the growth rate of output. In the current databases, the rate of return or the growth rate is an object of econometrics. Also, it is endogenous that the relative share of capital is the product of the rate of return and the capital-output ratio. In the current databases, each of the relative shares of capital and labor, the rate of return, and the capital-output ratio is estimated partially and empirically for a certain periods. The rate of return is estimated in the discrete time, based on actual or residual total factor productivity (TFP). The rate of return, at the Real-Time analysis in the continuous time, is estimated using Log differentials, independently of the relative share of capital.

Furthermore, there is no integration between the discrete and continuous time. A typical fact is that index numbering, discrete by nature, is commonly used at the Real-Time analysis but, its proof, evidence, or fact is never disclosed, as long as the author has investigated (e.g., see hundred papers by Dievert, Erwin, W.). This is because the factor reversal test does not essentially hold at the Real-Time analysis. This fact is traced back to the general equilibrium whose character is static while index number theory dynamically needs the price index by year under the market principle. In short, it is most difficult to integrate or synthesize the discrete and continuous time. The endogenous system is based on the discrete time and formulates endogenous equations hidden in the discrete Cobb-Douglas production function. Without using the discrete C-D production function, non-linear equations are not successfully formulated under constant returns to scale.

4. Revisit databases and EU KLEMS database, actual versus endogenous

4.1 Revisit the current databases, actual versus endogenous

This section first summarizes proper defects and the initialization of databases, and some similarity to KEWT. Second, touches up-dated outlines of the EU KLEMS.

First, discrete and continuous models and their use of databases each set initial values or ratios given. Also, each database commonly divides sectors by the type of industries or firms. It implies that the results differ by initial data-setting and that the database is micro-oriented. The
current databases commonly have these defects. Suppose that the initial data are consistent with each other by year and over years. Then, results differ by year and, never repeat the same even in equilibrium, similarly to actual statistics. Note that actual data are within a certain range of the corresponding endogenous data. This is true in the case of the endogenous system. In the case of the general equilibrium, results are expected to repeat since the target is to find stylized facts or hypotheses. The higher the correlation coefficient the higher the reliability is.

From the viewpoint of the initialization, let the author first explain the discrete time results presented by Harberger, A. C. (7, 8, 11, 15, 1998). Profiles of total factor productivity (TFP) growth among U. S. manufacturing branches are shown in his Figure 1 using four periods, 1970-75; 1975-80; 1980-85; and 1985-90, where ‘percentile’ is commonly used on the x for initial value added and on the y axes for Real Cost Reduction (RCD). Figure 1 shows the initial setting every five years. Real Cost Reduction (RCD) corresponds with the actual change in TFP. His Figure 2 compares cumulative sum of RCR with cumulative rate of TFP growth. If the percentile of initial value added increases up to the right, it is called Sun-rising while if it decreases, it is called Sunset. The peak of RCD and TFP differs by initial setting year and by industry, between percentile=0 and =1.0 on the percentile of initial value added on the x axis. As a result, the frequency of average annual TFP growth rate differs significantly by TFP growth rate, spreading over plus and minus, as in Mexico, 1984-94 (see his Figure 6A). The author here pays attention to Appendix on methodology (ibid., 29-30), where the rate of return is calculated ex-post using standard average values. The author interprets here that RCR=0 means an equilibrium and if RCR=0 is endogenous measured, RCR=0 is replaced by marginal productivity of capital \( (MPK) \)=the rate of return \( r \) and, marginal productivity of capital \( (MPL) \)=the wage rate \( w \), where perfect competition holds, free from its assumption.

Second, this section explains ‘a Real-Time set’ in the continuous time results presented by Croushore, D. and Stark, T. (2001, 2003) and Croushore, D. (2011). This constitutes a starting point to EU KLEMS. The theoretical background was earlier designed by Samuelson, P. and Solow, R. M.(1956) and recently, by Durlauf, Kourtellos, and Minkin, A. (2001). The corresponding database is now arranged by EU KLEMS Part I, Methodology, the Conference Board (as a consortium; 2007; for industry levels, see O’Mahony & Tummer, 2009). The above data-sets or database in the continuous time is settled by a concept of real-time, using vintage, perpetual inventory method (PIM), index numbering, and the initial data once 5 years. The Real-Time is far from simultaneous in the endogenous system. The initial data is a compromise between discrete and continuous. The author indicates that if the index numbering is empirically proved by Factor Reversal Test (FRT), it might be wholly accepted as a base data-set for economic analyses designed by aspect. Sato, K. (1974) left a proof that ideal index numbers almost satisfy the Factor Reversal Test (FRT), exceptionally as one of three cases, according to Theil, H. (1974); since then, there has been no proof of the relationship between index numbers and FRT.

Econometrics uses actual independent data and derives and estimates equations as targets by aspect while the endogenous system supplies universal data-sets starting with endogenous equations. Once more, actual estimated data are always within a certain range of endogenous data so that it is cooperative for researchers to work with each other.
4.2 EU KLEMS database, actual versus endogenous

EU KLEMS is based on flow data by country and does not connect flows with stocks theoretically and empirically. The Database of EU KLEMS (i.e., O’Mahony, M., and Timmer, M. P., 2009, F374-F403) has developed with the consortium of world researchers (hereunder, the Database, for simplicity). The Database estimates investment and capital using vintages by industry, whose thought comes from Jorgenson (1963) and, Jorgenson and Griliches, Z. (1967); the rate of capital consumption is determined by vintages under Perpetual Inventory method (PIM). The Database also follows Schreyer, Paul (2004, 2007), whose thought is related to Diewert, E.W. (2001, WP 01-24). The Database holds under constant returns to scale (CRS); so that an internal rate of return is estimated as a residual by industry, with an assumption that extra returns are zero and the same within the industry, supported by a prevailing micro base.

Currently, International Productivity Monitor 21 (spring, 2011) using the EU KLEMS growth accounting raises a question why growth in Europe for 15 countries differs from the US. The growth accounting uses Log-growth in the continuous time and compares GDP, GDP per capita, and GDP per hour worked. The Database shows productivity measure by industry. Contrarily, KEWT series introduces original 25 actual data (10 from the real assets and 15 from the financial assets and markets) by year from IFSY, IMF. Data and results completely hold in the discrete time match each other, and connected with IFSY, IMF.

5. Conclusions: Characteristics of investment and capital stock

KEWT is a unique data-sets in that net investment as flow and capital as stock are consistent with each other by country, sector, year, and over years with no revision later year for correction, and that the KEWT and its recursive programming by the same year for the transitional path are consistent, where non-linear equations and their hyperbola functions prove evidences and facts, theoretically and empirically by year. All the initiation data are not given but endogenous, which proves no existence of assumption and externality, without falling into tautology.

The net investment deducting endogenous capital consumption and excluding investment in inventory holds at $Y_G/Y = T_{AX}/Y$, where endogenous taxes are $T_{AX}$ and income=expenditures=output is $Y$. EU KLEMS needs an assumption that actual GDP less capital consumption equals $C+S$, which equals the sum of wages and profits, $W + \Pi$. Yet, the actual results in the literature are consistent with those at KEWT. For example, see Rassier, Dylan, G., 2012; The Role of Profits and Income in the Statistical Discrepancy, Survey of Current Business: 8-22. It coincides with a fact that the actual data are within a moderate range of endogenous data.

KEWT simultaneously takes five processes under perfect competition to measure (i) the rate of technological progress, $g_A^t = (1 - \beta^t)$, and (2) capital stock, $K = K_G + K_{PRI}$, with (iii) the relative discount rate of capital goods to consumer goods out, $(\rho_A/\rho) = 13.301c^2 - 22.608c + 10.566$, (iv) the relative share of capital, $\alpha = 1 - (c/(\rho_A/\rho))$, and, (v) the rate of return to the wage rate, $(r/w) = ((\alpha/(1 - \alpha))/(K/L))$, where the capital-labor ratio, $k = K/L$, and endogenous Total Factor Productivity (TFP) is $A = TFP = k^{1-\alpha}/\Omega$ (see Note 19 in PhD thesis).
The author compared the data-sets of the US with Japan, 1960-2010, for ‘long periods’ using KEWT 6.12-6. Also the author compared the data-sets of the US with Japan, 1990-2010, for ‘short periods’ using KEWT 6.12-1 for 17 Asia and Pacific countries. The author raises a question: how to settle all the initial data at 1990 when long periods are taken? Conclusively speaking, the longer the periods the more stable/moderate the endogenous results are. Look at Figures 9-1 and 9-2 for test. When the values in 1990 for long periods are completely used for the initial value of 1990 for short periods, the trends are smoother than the case when the initial data are adjusted within short periods. It suggests that the data periods should be longer. Two problems remains at statistics, IFSY, IMF: (i) Quality of original actual data has been better gradually over years, by country. (ii) Deficit by country is not always disclosed by year and over years, where two alternatives exist; cash flow-in and -out or saving less net investment at the government sector real assets. Real assets are of course consistent with the structure of the balance of payments.

The difference between actual and endogenous capital stock in Japan is much smaller than that in the US. This is traced back to a significant difference of the growth level between two countries that reflects the difference of debts over years, in addition to the difference of the actual growth rate of population. Log-growth and Real-Time analysis depends on the magnitude of investment flow by year and thus, needs careful review. KEWT realizes a maximized rate of return with a minimized net investment in a moderate endogenous-equilibrium, as shown at the rate of return hyperbola function to the ratio of net investment to output by year.
Data sources: KEWT 6.12-5 and related books (the same hereunder).

Figure 1 Capital stock and output, actual and endogenous by sector: Japan, 1960-2010

Figure 2 Structural ratios, actual and endogenous: Japan, 1960-2010
Figure 3 Net investment by sector and the structure of the BOP, deficit, and taxes, actual and endogenous: Japan, 1960-2010


Figure 4 Capital stock and output, actual and endogenous by sector: the US, 1960-2010

Figure 5 Structural ratios, actual and endogenous: the US, 1960-2010

Figure 6 Net investment by sector and the structure of the BOP, deficit, and taxes, actual and endogenous: the US, 1960-2010

Figure 7-1 Policy-oriented preceding structural ratios by sector, 1960-2010: Japan

Figure 7-2 Policy-oriented structural ratios by sector, 1960-2010: Japan
Figure 8-1 Policy-oriented preceding structural ratios by sector, 1960-2010: the US

Figure 8-2 Policy-oriented structural ratios by sector, 1960-2010: the US

Figure 9-1 Policy-oriented preceding structural ratios by sector, 1960-2010: the US (for test)

Figure 9-2 Policy-oriented structural ratios by sector, 1960-2010: the US (for test)

Figure 10 Endogenous and actual basic ratio comparisons to support capital stock: Japan, 1960-2010

Figure 11 Endogenous and actual basic ratio comparisons to support capital stock: the US, 1960-2010
References


**References behind the endogenous system, including the first appearances:**


Kamiryo, Hideyuki. (2010c). Policy-Oriented Endogenous Model and Its Data-Sets KEWT 4.10 in Equilibrium; 65+xip.; with 63 figures. Monograph, Hiroshima Shudo Univ. (For the Excel files, please ask using the author’s email address, kamiryo@ms3.megaegg.ne.jp).


