Chapter 6

Capital Stock and Its Rate of Return, Japan *vs*. the US, 1960-2011, Purely Measured under *No* Assumption

6.1 Review of Representative Databases: With Capital Stock and the Rate of Return

This chapter presents a key to understanding the character common to the current representative databases. It is impossible for the current databases to measure capital stock endogenously. This is because the rate of technological progress, and accordingly, the rate of return and, the relative share of capital are only measured in the endogenous system. The author has used respectively databases of UN, IMF, OECD, Eurostat, and others after the 1980s. The author has failed to estimate the above three ratios, directly using the current databases. The experiences have stimulated the author to set up a homemade database, i.e., the KEWT database.

This chapter aims at calling after a blue bird, just like a child. The author already found a second blue bird at several articles written by Jorgenson and Griliches (1967) and Jorgenson (1963, 1966). The second bird's object was not the embodied and/or disembodied hypothesis but the confirmation of precise assumptions used at their models. Examining assumptions is essential to the comparison between the current various databases. This chapter explains why no assumption by using nine BOXES. This section preliminarily outlines the current databases.

EES is a whole naming to author's endogenous economic system and its Kamiryo Endogenous World Table (KEWT) database and further its recursive programming for the transitional path by year. Capital stock and its rate of return are simultaneously measured and consistently involved in EES as a whole system. Capital stock and its rate of return connect the current world databases with EES, through a common fact that statistics data are always within a narrow range of endogenous data in equilibrium.

First let the author outline the current representative databases. The author has paid a special attention to Penn World Table (PWT, and EPWT). The author recollects the past days, with Heston Alan and Ye Wang. The author was once shocked with a fact that PWT stopped publishing the capital-labor ratio after 1996. The author now understands and admires the brave decision-making. Economics and econometrics have marched together but a little differently, as suggested by Jorgenson and Griliches (1967). OECD national accounts data (http://OECD.com with market data explanation of Paul.Schreyer@OECD.org) publishes capital stock for corporate sector but not consecutively/periodically. The UN does not publish capital-related data (UN: http://unstats.un.org/unsd/snaama/selectionbasicFact.asp).

In the last decade, representative databases have been rapidly well-arranged, marching with the progress of econometrics: The representatives: NBER, http://nber.org; KOF, http://globlization.kof.ethz.ch ; EU KLEMS, http://www.euklems.net/euk09i.shtml ; Real-Time, http://www.philadelphiafed.org/research-and-data/; ddgg to 10 sectors, http://www.ggde.net/dseries/10-sector.html . Time-Use such as MTUS & AHTUS, where time-series preferences by country are available (see "Accounting for Household Production" by Landefeld, Steven, J., Fraumeni, Barbara, M., and Cindy, M., Vojtech (*Review of Income and Wealth*, June 2009); http://www.timeuse.org/information/links. And fundamentally, IMF and the World Bank, where the KEWT database introduces 25=10+15 original data from *International Financial Statistics Yearbook*, IMF, http://imf.org ; http://data.worldbank.org by aspect. This chapter does not explain each characteristic in detail. Instead, the next section discusses the essentials of capital and labor and relationship between stocks and flows. Nine BOXES outline the essentials overwhelmingly.

Capital stock is published as the data of a system for national accounts (SNA, 1993), by several countries consecutively. For example, the Bureau of Economic Analysis (BEA), Dept of Commerce, the US (http://www.bea.gov), had published capital stock so long until recently. Annual Report on National Accounts, Cabinet Office, Japan (http://www.esri.cao.go.jp/), has published capital stock based on real-assets over years. Swiss Federal Statistical Office, National Accounts information, publishes net non financial capital stock by industry (geometrical method). This database (http://www.bfs.admin.ch/bfs/portal/en/index/themen/04/0204/key/stock_cap.html) covers twelve Industries and total.

This chapter focuses on the comparison of capital stocks and the rates of return in Japan and the US. It was a great challenge for the BEA to publish the estimation of capital stock in its *Survey of Current Business*. The BEA, however, stopped publishing capital stock in 2007. Section 3 compares the enlarging differences lying between BEA capital stock, 1960-2007, and EES capital stock, 1960-2011.

The BEA, in 2007, turned to estimate 'profits' by year at enterprise level, instead of 'capital' stock. This fact suggests a useful viewpoint to EES. The BEA challenges for brave trial and error and cooperates with the framework of the SNA. The BEA publishes the following note and papers concerning profits/returns:

1. Lally, P. R; Note on the returns for domestic nonfinancial corporations in 1960-2005. *Survey of Current Business* May 2006: 6-10.

2. Lally, Smith, Hodge, and Corea; Returns for domestic nonfinancial business. *Survey of Current Business* May 2007: 6-10. Since then, updated contents are published consecutively by year, 2008, 2009, 2010, 2011, 2012; Lally, Hodge, and Corea; Hodge, Corea, Green, and Retus.

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The above note and papers show rates of return and shares of value added, before and after tax, at enterprise level, based on *GDP*. National disposable income is the sum of wages and returns after adjusting net primary income from abroad: $Y = W + \Pi = C + S$ or $Y = W_G + \Pi_G + W_{PRI} + \Pi_{PRI} = C_G + S_G + C_{PRI} + S_{PRI}$. The BEA uses flows instead of stocks, similarly to Jorgenson (1963). A problem remains at the government sector. When deficit is shown by cash flow -in and -out, the rate of return at the government sector is zero so that the total economy is not distinguished with the private sector.

These facts suggest that it is difficult for the SNA to publish capital stock based on the real-assets. The author's EES presents a robust database in the world today in that pure consistency brings about no assumption and no initialization, where data are not interrupted by estimated values of elasticity and differential. This robust database may last as long as 'purely endogenous with no assumption' is maintained. 'Purely endogenous' means that capital stock is measured completely within the author's policy-focused system and without using accounting method such as Perpetual Inventory Method (PIM) and/or financial market data such as the user 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 estimated in the literature is based on a system of national accounts (SNA, 1993) that aims at records and accordingly, uses final income after redistribution of taxes and deficit by 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 understanding, holds with econometrics-methodology that applies a variety of parameters to each model and freely uses changing statistics and other various 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 & 7.13 (http://riee.tv). KEWT 6.12 measures all the parameters and variables for 81 countries, 1990-2010 (i.e., for short periods) and 1960-2010 (i.e., for long periods), within its system. KEWT 6.12 & 7.13 each obtain 25 original data, 10 from real assets and 15 from financial/market assets, thanking for *International Financial Statistics Yearbook, IFSY,* IMF (http://imf.org ; http://data.worldbank.org , by aspect).

Penn World Table (PWT 6.1, after 5.6, 1950-1995) has bravely stopped the publication of the capital-labor ratio after 1996 for a few reasons, as the author 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. Besides, markets are independently vertical by market, e.g., capital, labor, financial, stock, and many others; respectively 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 explicitly shown just before final income redistribution. Regardless of parameters or variables, the total economy is the sum of the government sector and the private sector, as an aggregate sum by year and over years. As a result, capital stock and its rate of return match in equilibrium and are purely consistent with all the other parameters and variables. Contrarily, there is no way in the literature to confirm the consistency among items by year and over years. The BEA, Washington, even though, bravely steps into how to estimate returns and household production within the framework of the SNA.

The author will revisit EU KLEMS for comparison, later before Conclusions.

6.2 Essentials of Capital Stock and Net Investment

This section presents the essentials of capital, stock and flow, in terms of measurability. Jorgenson (1963, 1966) and J & G (Jorgenson & Griliches, 1967) are compared with the essentials of EES. Six BOXES are used for explanations. Its manuscript was once presented at Second Poster Session, *International Association for Research in Income and Wealth Conference*, Boston, on Aug 9, 2012. First of all, the character of capital is compared with that of labor or population (see BOXES 6-1 and 6-2). Readers will broadly understand how EES differs from neo-classical models (for notations and equations, see Notations and Notes).

The author highly appreciates the figure of J & G (1967, p273) below (no number on this figure on page 273). This shows an inconsistency lying between stock and flow. Nevertheless it clarifies that flow is first even if stock is unknown. For this figure, the author got permission at the Permissions Department, Cambridge University Press.

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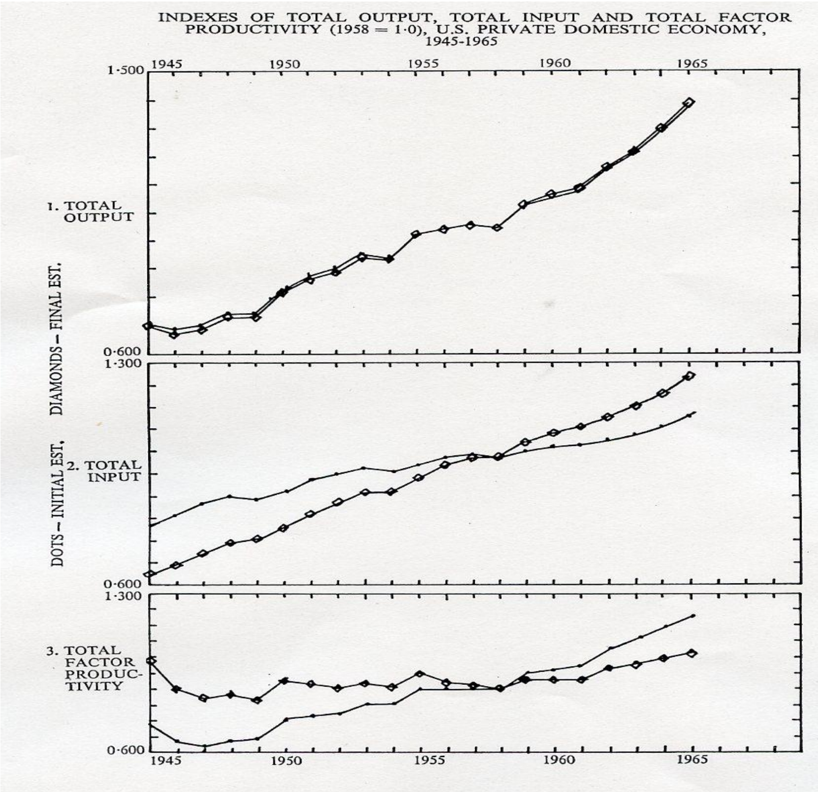
BOX 6-1 Basic concepts set between capital and labor: Jorgenson (1963, 1966) and J & G (1967)

1. Capital stock: The literature treats capital, quantitatively and homogeneous of degree one. Quality is separately shown using the price level or index under the price-equilibrium, where the rate of interest is a surrogate for the rate of return. Total factor productivity, *TFP*, and profits are shown respectively as an ex-post residual.
2. Labor/population: The literature similarly treats labor/population quantitatively. The quality of labor/population is somehow separated using human capital stock.
3. Capital flow: The literature separates capital flow or net investment from capital stock. Net investment is established without capital stock or independent of capital stock. Capital flow is as economically while capital stock is estimated as accounting-oriented.
4. Labor/population flow: The literature quantitatively counts the increase in labor/population. Labor flow corresponds with the increase in labor stock.
5. The literature has settled the rate of technological progress not pure-endogenously but exogenously.
6. Accordingly a residual ex-post growth rate of *TFP* (STOCK) is a surrogate for an external rate of technological progress (FLOW).

The proof of J & G (273, 1967) has been well accepted econometrically: Jorgenson and Griliches (273, 1967) shows overlapping error of output/input of *TFP*.



Note: Wiley permitted the author to use this figure, Sep10, 2012 (see Acknowledgements and Preface).

BOX 6-2 Basic concepts set between capital and labor: EES

1. Capital stock: Capital stock cannot separate its quality from quantity; not interrupted by the level of price. Capital stock changes consecutively but, its price level changes by second/minute. Capital stock is endogenously converted to returns and priced solely using the rate of return, $r = \Pi/\mathrm{K}$.
2. Labor/population: Similarly to capital stock. Labor flow is converted to wages and priced solely using the wage rate, $\mathrm{w} = \mathrm{W}/\mathrm{L}$.
3. Capital flow: It is a fact that capital stock and capital flow are, indispensably and consistently, united into one unity.
4. Population flow: Similarly to capital stock and capital flow.
5. EES purely measures an endogenous rate of technological progress (FLOW).
6. EES measures the growth rate of TFP (STOCK). At convergence* in the transitional path and under the endogenous-equilibrium, $\mathrm{g}_{\mathrm{A}}^{*} = \mathrm{i}(1-\beta^{*}) = \mathrm{g}_{\mathrm{TFP}}^{*} = \mathrm{k}^{*(1-\alpha)}/\Omega$ is measured. An endogenous turnpike equation exists for the transitional path.

Next, BOXES 6-3 and 6-4 clarify a base for 'no assumption.' The essence of assumptions is, to the author's understanding, 'indispensable,' due to no way but set assumptions.

BOX 6-3 *TFP*, *MRS* and elasticity of substitution, *sigma*, at J & G (1967) and Jorgenson (1963, 1966)

1. J & G (1967) empirically and econometrically proves that Solow's (1957) output/input productivity growth rate includes some double counts in input and output. Jorgenson proposes the use of capital flow (net investment) for an ex-post measurement of the growth rate of output to the input of total factor productivity, *TFP*.
2. J & G (1967) takes the assumption of the marginal rate of substitution, *MRS*, being equal to 1.000. This assumption may constitute a surrogate for an assumption of perfect competition.
3. Jorgenson (2, 1966) repeatedly stresses that the differences between econometrical results comes from not the differences of models but the differences of assumptions. The author is encouraged by his insight.
4. Why did J & G (1967) and Jorgenson (1963, 1966) not step into a core lying between capital stock and capital flow? A reason: Jorgenson remains the neo-classical framework and relies on individual utility function under the price-equilibrium to reinforce the market principle. An smooth expansion of micro to macro is difficult to attain at neo-classical framework, without a methodology to step into an endogenous paradigm enlarged from a partial micro to a whole macro.

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Scientific discovery requires equations. If a researcher could not formulate an equation, he/she has to set corresponding assumption(s) so that a discovery of an article holds scientifically. In short, a discovery has two alternatives, equations or assumptions. Marginal productivity theory (*MPT*) has historically occupied a centre of the literature; typically even today, i) total factor productivity (*TFP*), ii) marginal rate of substitution (*MRS*), iii) elasticity of substitution, *sigma*, and iv) no extra profits/returns for the one input change to the total output change. This chapter focuses the above i) to iii).

BOX 6-4 *TFP*, *MRS* and elasticity of substitution, *sigma*, at EES

1. From the viewpoint of a whole system, EES connects capital stock with capital flow/net investment. The growth rate of *TFP* shows not a flow growth but a stock growth. EES wholly and simultaneously measures the rate of technological progress (FLOW) and the growth rate of *TFP* (STOCK), by year.
2. EES proves a true meaning of the elasticity of substitution, *sigma*, with no assumption. The *sigma* holds with the marginal rate of substitution (MRS)=1.000 by country.
3. EES, as an empirical result of the above proof, withdraws two assumptions, MRS and *sigma*, and replaces each assumption by a corresponding endogenous equation. It definitely implies that perfect competition is also withdrawn from an assumption.
4. EES has withdrawn all the assumptions found in the literature and replaced these assumptions by the equations of *seven* endogenous parameters* in an open economy.
5. EES revolutionarily constructs a new paradigm of earth endogenous system (EES) under purely endogenous** and cyclical distinction. Cyclical holds with less net investment and a plus technological progress; never zero sum. The Earth has limited resources and green reinforce cyclical economy. EES is based on real-assets and the neutrality of financial/market assets to real-assets. EES is consistent with the market principle and never attracts bubbles.

Notes: * *Seven* parameters are: net investment to output 1) $i = I/Y$, and 2)$i_G = I_G/Y_G$ at the government sector, the rate of change in population ; 3) $n = (L_t - L_{t-1})/L_{t-1}$ and 4) $\alpha = \Pi/Y$, each fixed in the transitional path; the above, 5) β, and 6) δ_0; 7) the speed years, $1/\lambda_t = (1-\alpha)n + (1-\delta_t)g_{A_t}$, each change in the transitional path and each in equilibrium. The rate of technological progress $g_{A_t} = i(1-\beta_t)$ turns to $g_A^* = i(1-\beta^*)$ at convergence.

** *Purely endogenous* holds under no assumption: the process that each initial data turns to purely endogenous at KEWT database.

i) Temporal setting an initial value by item.

ii) Test the stability of the speed years by country.

iii) Test the stability of the speed years by sector (G and PRI).

iv) Watch dynamic balances between the two sectors, G and PRI; finally no change or close-to-no change appears. At this timing, moderation of the corresponding item reaches its extreme. This situation is called a moderate range of the endogenous-equilibrium.

Thirdly, BOXES 6-5 and 6-6 present the processes to withdraw assumptions, using MRS and *sigma*. BOX 6-5 indicates that the light is off on the way. BOX 6-6 presents the processes to the end; until three assumptions are completely withdrawn. Two assumptions, MRS and *sigma*, hold at neo-classical models. The current representative databases are available, summarized in section 6.1 and based on neo-classical and Keynesian. Suppose that the literature dares to use data-sets of EES or KEWT 7.13 in parallel with other available databases, then, the current circumstances change at once. This is because actual statistics data are always within a certain range of endogenous data of EES. A common base of databases is 'amounts and values', but not ratios. This is a precious scientific discovery of this chapter, which is commonly applicable to the current databases. This was proved by using the current databases (see the previous section). The KEWT database has tested the identity of *sigma* in various ways. KEWT 7.13 proves *sigma* empirically by country and for 81 countries, as done in this section.

BOX 6-5 Numerical synthesis of *MRS* and *sigma*: Jorgenson and neo-classical models

1. The marginal rate of substitution (*MRS*) and the elasticity of substitution (*sigma*) hold under the price-equilibrium. It is expressed using the Euler's theorem, based on individual utility, commonly to Robinson (1934) and Neo-classical.
2. The continuous Cobb-Douglas production function is united with neo-classical and the Euler's theorem. Partially endogenous at continuous time does not consistently spread over a whole system in the discrete time; continuous theory vs. discrete data.
3. No database publishes capital *K* consistently with all the other parameters and variables.

BOX 6-6 Numerical synthesis of MRS and *sigma*: EES

1. EES proves the neutrality of the financial/market assets to the real-assets.
2. The discrete Cobb-Douglas production function becomes familiar with the data related to accounting, financing, national accounts, and statistics. EES produces *seven* endogenous equations yet, these equations are non-linear and replaced by hyperbolas by ratio. *Seven* endogenous parameters are a core of the whole endogenous system.
3. *MRS* and *sigma* are melted in discrete time and synthesize a unity proof empirically. The method is manipulated so as to equal the ratio of the change in two factors to the change in the total output/income, using the real assets and with relative price, *p*=1.000.

1) ΔL remains given: $\Delta L^* = \Delta L$.

2) $MPL = w = (Y - \Pi)/L$ and $MPK = r = \Pi/K$. The *sigma* is involved in MRS. $MRS = (r/w)$ and $\Delta MRS = \Delta(r/w)$. $\Delta MRS = (r/w)_t - (r/w)_{t-1}$.

3) Simultaneously $\Omega = \Omega^* = \Omega_0$ and $r = r^* = r_0$ hold, based on the constancy of the capital-output ratio of Samuelson (1970) and under $\alpha = \Omega \cdot r$ as a connectors.

4. The relationship between discrete and continuous time finally matches.

Note: EES measures Y=income=expenditures=output by country using the real assets in an open economy. Samuelson's (1970) constancy of the capital-output ratio completed by Sato's (1981) (see Notes).

6.3 Simultaneous Measurements of Capital and the Rate of Return using Japan and the US, 1960-2011

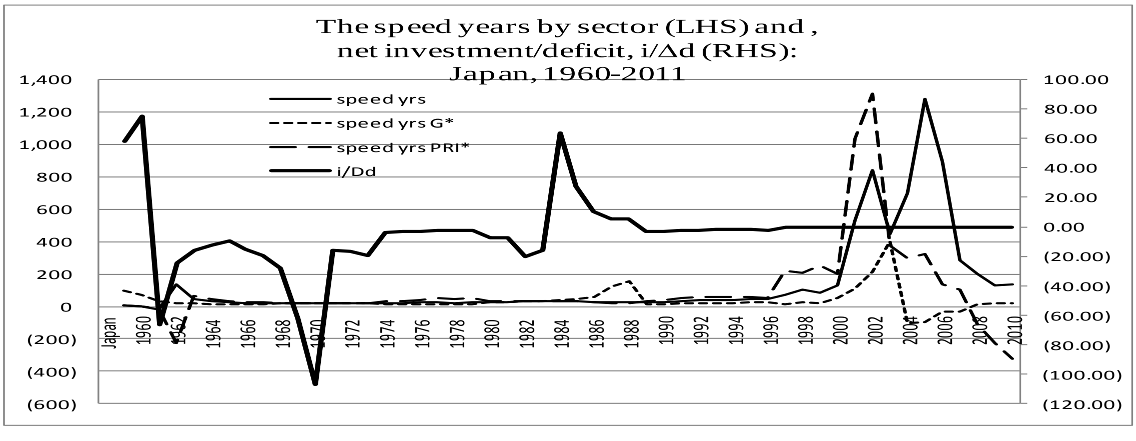
This section takes Japan and the US, 1960-2011, proves whole consistency for simultaneous measurements of capital and the rate of return, and expands 'amounts and values' to related ratios and compares actual/estimated data with endogenous data using KEWT 7.13 database. The two country comparison expresses the essentials of capital and labor, stocks and flows. Other chapters respectively express essentials of other aspects such as robustness of an economy, economic stages, national taste/preferences and culture, fiscal multipliers, business cycle, stop-macro inequality, and the relationship between the rate of change in population and the rate of technological progress. Some of these aspects overlap by nature. Fundamental background is common to respective aspect since endogenous equations exist behind and, under the endogenous-equilibrium and perfect competition. Note that Samuelson (1937, 1967) never contradicts EES.

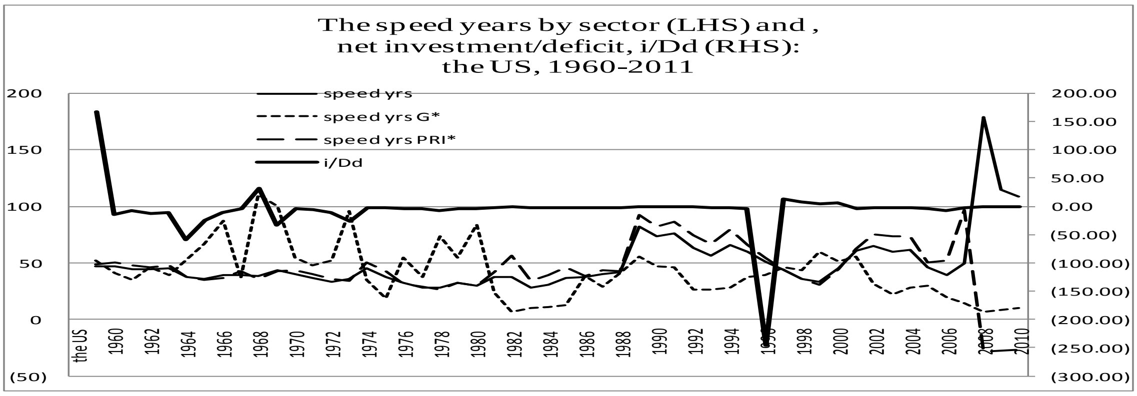
Core results are shown using BOXES 6-7, 6-8, and 6-9, with **Figures 1** to **12** at the end. The author tested (as definition of test), complete consistency between *Long* periods (1960-2011) and *Short* periods (1990-2011), by inserting *Short* into *Long* data by country.

Japan in BOX 6-7: The speed years by sector, as a direct measure of endogenous equilibrium, are like Sun rising and Setting or lifetime of a man or woman. After 2000, Japan' equilibrium is out of controllability and waiting for default, due to excessive deficits and debts, after sudden sacrifice of G and PRI (watch the trend of $i/\Delta d$).

The US in BOX 6-7: The speed years by sector are robust like a youth, except for 2008-2011. Excessive consumption guards endless debts. After 2008, moderate equilibrium collapses at sudden sacrifice of G and PRI (watch the trend of $i/\Delta d$).

BOX 6-7 The speed years by sector to support 'net investment/deficit,' 1960-2011: Japan vs. the US, using KEWT 7.13-6





The background is: When deficit is zero, the growth rate of output is most robust, universally by country. Samuelson (1942, 1975) proved this discovery theoretically (for proof, see Chapter 13). Hitherto the author's macro analyses have never proved that the higher the increases in *Y* and *K* the more robust an economy is. Most typically BOX 6-8 for output flow and capital stock shows this discovery at the real assets under perfect competition.

Japan in BOX 6-8: Output and capital, *Y* & *K* and, the corresponding Y^* & K^*, at convergence*, 1960-2011, surprisingly show the same Sun rising and Setting results of endogenous equilibrium as those at BOX 6-7. The difference between *K* (at a highly increasing level) and K^* (at a low moderate level) has been widen after the 1990s. The G saving turned negative in 1992 after badly exhausting the accumulated G savings. This fact tells us a true long story. Actual policies solely aggravate actual results. As a result, *Y* overlaps Y^*. $Y = Y^*$ is equal to such that there is no room for growth. The situation stands for constant returns to capital (CRC). Endogenously zero-growth expresses CRC under constant returns to scale (CRS). The results overwhelmingly come from a low consciousness of democracy; directing for selfishness and against next generations. Today people wait not for lip service but for essential real asset policies. A grass hopper waits for winter as in Aesop's Fables; time has come. Negative turns to Positive as shown by author's geometric hyperbola (an inverse number of an endogenous equation) and its philosophy.

The US in BOX 6-8: The above fact is the same but, quite differently in the case of the US. Contrarily, *K* overlaps K^*. $K = K^*$ is equal to such that there is much room for growth. This fact implies that maximum returns have realized with minimum net investment by year and over years. Nevertheless, it does not mean that the US economy continues to grow robustly in the future. This is because the US economy faces at sudden difficulties in 2008-2011. Both *K* and K^* suddenly and unbelievably fluctuate in 2008-2011. Endogenous equilibrium is out of controllability. Future results depend on the current actual policies so that future results are not foreseen at the current point of time.

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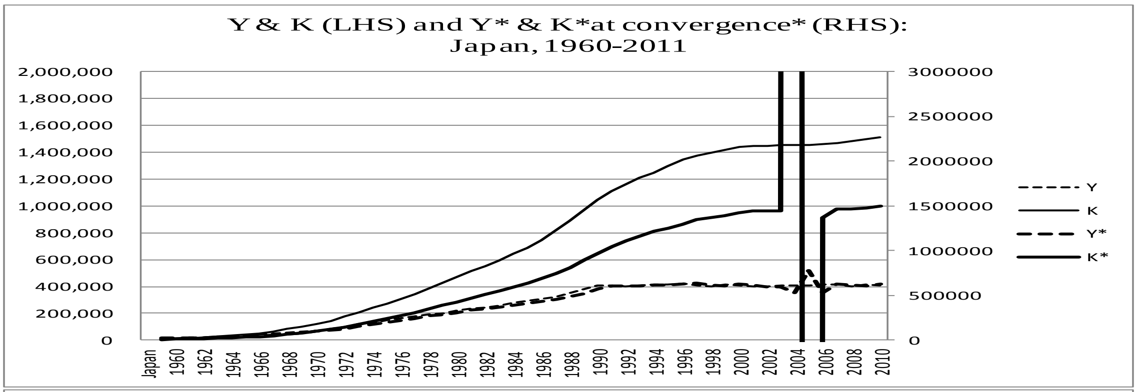
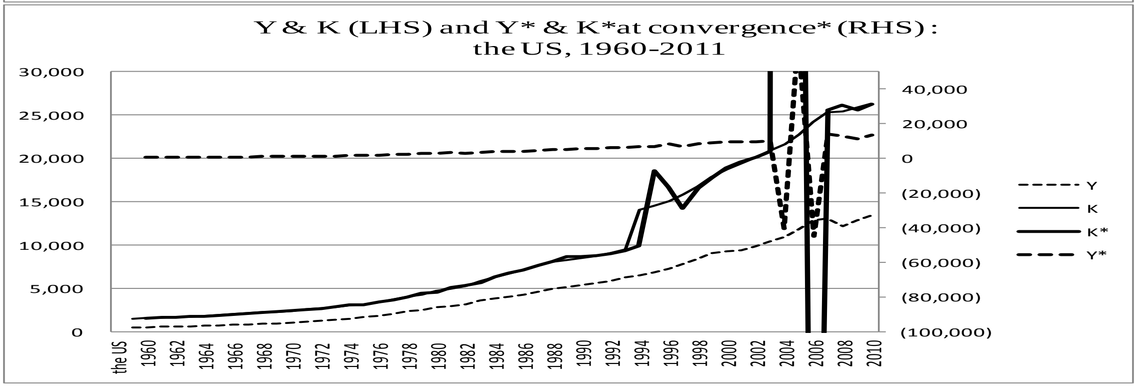
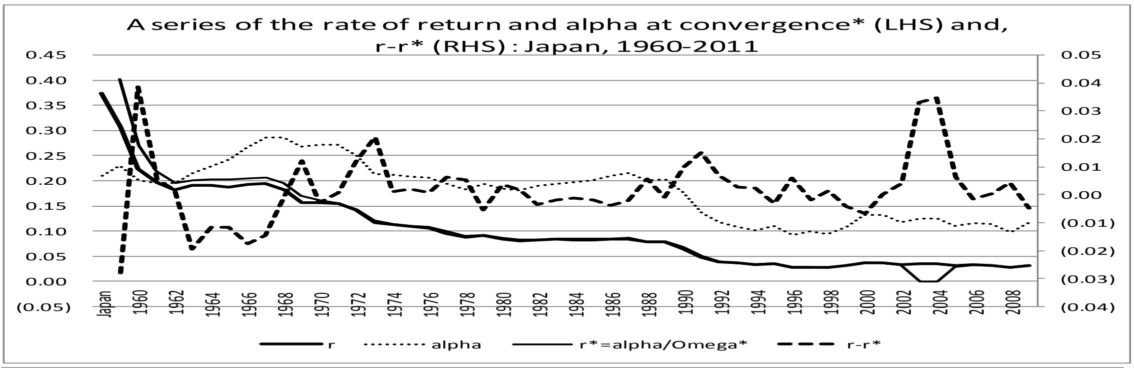
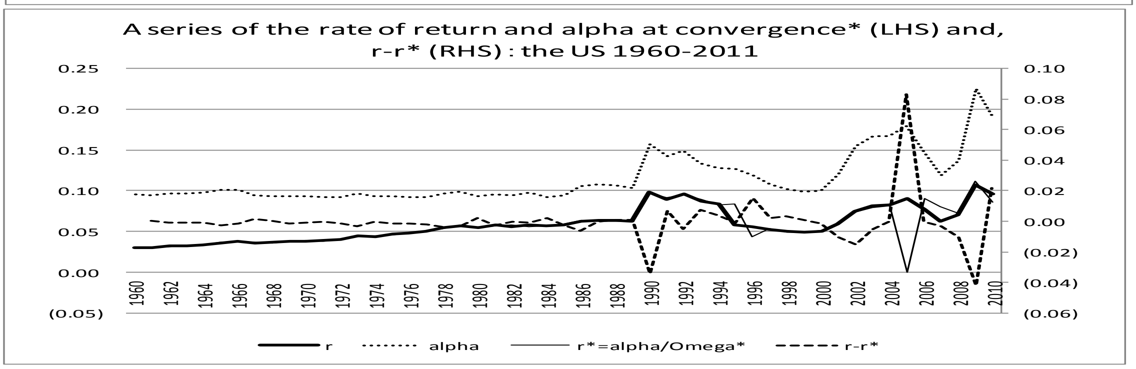
BOX 6-8 Y & K and Y^* & K^* at convergence*, 1960-2011, under $\alpha = \Omega^* \cdot r^*$: Japan vs. the US, using KEWT 7.13-6





BOX 6-9 The rate of return, r, r^*, and $r - r^*$, the current and at convergence*, and the relative share of capital, α: Japan vs. the US, 1960-2011, using KEWT 7.13-6





<u>Japan in BOX 6-9</u>: The rate of return decreases gradually. It implies that economic policies are against sustainable growth and returns. This cause is not the transition of economic stages but failures of real-assets policies at the macro level. The relative share of capital has decreased after government saving turned to minus in 1991. Further, $r - r^*$ has increased 'positively' after 2000. Japan has naturally fallen into disequilibrium due to irresponsible deficits over years.

<u>The US in BOX 6-9</u>: The rate of return increases gradually; proportionally to the relative share of capital. $r - r^*$ has fluctuated after the 1990s. If $r - r^*$ increases 'negatively,' this must be a better sign: The rate of return at convergence is higher than the current rate of return in equilibrium. This is not a better sign. Any country cannot run beyond its endogenous size of government (see Chapter 13).

The rate of return and the growth rate of output march together so that policy-makers could control each level, when deficit decreases less than a certain level of deficit, relative to *GDP* or *Y*. BOXES 6-7, 6-8, and 6-9 empirically reinforce a scientific discovery as first found by Samuelson (1942, 1975) (see Chapter 12).

6.4 Revisit Databases and EU KLEMS Database, Actual *vs.* Endogenous

6.4.1 Databases and econometrics: discrete time versus real-time

This section first summarizes a few defects pertinent to databases, with a problem of initialization. KEWT database before completion had similar problems but, solved these defects. Second, touches up-dated outline of the EU KLEMS.

First in Sub-section 6.4.1, the current databases commonly have the following character. The current databases each set initial values or ratios given. Each database commonly divides sectors by type of industries or firms since macro and micro are harmonious, based on individual utility function. Suppose that the initial data in databases are set arbitrary or given and adjusted. Then calibration works smoothly. There is no way but to adjust each initial data, unless databases are perfectly cyclical as a system or purely endogenous (see Note**, BOX 6-4). This is a fait or character of databases. When databases rely on the market data, data-setting becomes complicated. What test arrangement is most fitted for checking the relationship between macro and micro data, actual and market data, and industry and households? Staff to arrange for databases copes with the difficulties and it is beyond description. As a result, data analyses become more complicated.

To the extreme, suppose that the initial data of a database are consistent with each other by year and over years. This case must be best and it must be EU KLEMS. Each value of EU KLEMS changes by year, similarly to KEWT database. Each value never repeats the same even under a most moderate equilibrium. Question 1 from an economist: How does the economist or model researcher apply a database to macro and micro model analyses? Some model researchers have conquered the difficulty to find new methodologies by using econometrics, as Klein, L. R., Diewert, E. W., and Jorgenson, D. W. Question 2: Then, what are application-differences existing between databases in the literature and the purely endogenous KEWT database? Model researchers must formulate respective model and equations with assumptions when they take advantage of databases. Model researchers are able to freely apply their econometrics or methodologies to the KEWT database. A researcher compares and analyzes resultant differences between two databases. In the case of KEWT data-application, the researcher is released from assumptions required for scientific discovery; since the KEWT database need no assumption and, all the endogenous equations prevail globally and universally by country. The KEWT database is full of scientific discoveries. Researchers are able to find new scientific discoveries by using their econometrics, in parallel with actual data-application of a current database available in the literature. For resultant differences between the current database and the KEWT database, researchers are always able to set the endogenous data as stable foundation.

Next in Sub-section 6.4.1, the following three aspects are selected for the above questions:
(1) Real Cost Reduction (RCR) by Harberger, A. C. (1998).
(2) Real-Time by Croushore, D, and Stark, T. (2001, 2003) and Croushore, D. (2011).
(3) Factor Reversal Test (FRT) by Sato, K (1974) and Theil, H. (1974).

First the author reviews the discrete time results pursued 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 axis for initial value added and on the y axis for Real Cost Reduction (RCR). His Figure 1 shows the initial setting every five years. Real Cost Reduction (RCR) 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 RCR 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 (29-30, ibid.), where the rate of return is calculated ex-post using standard average values. The author interprets his view such that RCR=0 means an equilibrium and that if RCR=0 is endogenously measured, RCR=0 is replaced by marginal productivity of capital (*MPK*)=the rate of return *r* and, marginal productivity of labor (*MPL*)=the wage rate *w*, where perfect competition holds, free from its assumption.

Second, let the author review 'a Real-Time set' at the continuous time pursued by Croushore, D, and Stark, T. (2001, 2003) and Croushore, D. (2011). This continuous case 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 currently arranged by EU KLEMS Part I, Methodology, the Conference Board (as a consortium; 2007; for industry levels, see O'Mahony & Tummer, 2009). The above database in the continuous time is settled by a concept of real-time, using vintage, perpetual inventory method (PIM),[1] index numbers, and the initial data once 5 years. The Real-Time is far from simultaneous in the endogenous system or EES. The initial data may be a compromise between discrete and continuous.

Third, the author indicates that if the index numbers is empirically proved by the Factor Reversal Test (FRT), it might be wholly acceptable as a database for economic analyses designed by aspect. Sato, K. (1974) left a proof that ideal index numbers almost satisfy the 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 the FRT.

Econometrics uses actual independent data, and derives equations by aspect while the endogenous system supplies a universal database composed of endogenous equations under no assumption. Once more, actual estimated data are always within a certain range of endogenous data so that it is easy for researchers to work with each other.

6.4.2 EU KLEMS database, actual versus endogenous: Comments on *International Productivity Monitor* 21, 2011

This sub-section compares EU KLEMS with the KEWT database. 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 Tummer, M. P., 2009, F374-F403) has developed with the consortium of world researchers (hereunder, EU KLEMS). EU KLEMS 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). EU KLEMS also follows Schreyer, Paul (2004, 2007), whose thought is related to Diewert, E.W. (WP 01-24, 2001). EU KLEMS holds under constant returns to scale

[1] 1) Accounting depreciation in PIM differs from endogenous depreciation in that an endogenous rate of technological progress is simultaneously involved in capital stock and flow. For endogenous capital and its depreciation, see *Journal of Economic Sciences* 11 (Feb, 2), 23-84 and also 12 (Feb, 2), 59-104.

2) Meads, J. E. (1-9, 1960) raises three factors, capital, labor, and land. EES includes land in capital as stock. Endogenous rentals are flow and composed of endogenous returns and depreciation. When lands are owned by government, endogenous rentals are replaced by tax increase. Tax increase is another word of economic robustness as first proved by Samuelson (1942). Due to less burden of deficit, China has competed internationally.

(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.

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. EU KLEMS shows productivity measure by industry. Contrarily, the KEWT database 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 simultaneously hold in the discrete time, consistently matching each other, and connected with *IFSY*, IMF.

It is true that databases become more global and universal and, still maintain each own characteristics. The current representative databases are connected with the KEWT database and its recursive programming, under a fact that actual statistics data are always within a certain range of endogenous data in the endogenous-equilibrium.

6.5 Conclusions

Capital stock and capital flow/net investment are most essentially involved in the real assets of national accounts. The current representative databases and capital flow in the literature are not integrated as a system. The author clarified the characters of these databases at Sections 6.4.1 and 6.4.2. Contrarily, the earth endogenous system (EES) connects theory with practice exactly. Simultaneous measurement of capital stock and the rate of return is one of cores at EES and its KEWT database, 7.13.

This chapter clarified the essentials of capital stock and net investment, by using BOXES 6-1 to 6-9 and comparing the literature with KEWT 7.13. These BOXES were first presented to Second Poster Session, *IARIW*, Aug 9, 2012, with its manuscript.

These essentials were cultivated upon a new fact that Jorgenson (1963, 1966) and Jorgenson and Griliches (1967) discovered double counting at output/input of total factor productivity, *TFP*, using actual data. At the KEWT database, the rate of technological progress (FLOW) and the growth rate of *TFP* (STOCK) endogenously march in parallel and cross at the convergence point of time. This fact is directly proved, using recursive programming for the transitional path. The KEWT database shows an *endogenous* turnpike in this respect (for detail, see Notes before Preface).

The author confirms that the *initial* data of 1960 at Long database, 1960-2011, and the *initial* data of 1990 at Short database, 1990-2011, each turn to *purely endogenous*, using KEWT 7.13. Essential differences at the real assets between Japan and the US are interesting to readers, as implied by BOXES 6-7, 6-8, and 6-9. The background of these essential differences is overwhelmingly shown by Figures 1 to 12, by aspect. These essential differences reflect the essence of real-assets causes and prove Samuelson's scientific discovery (1942; 1975 with Salant) (see Chapter 13).

Readers will understand why the author revisited the current databases, particularly EU KLEMS. The current databases are universal. Most important is how to settle assumptions by database, cooperatively with other databases: If assumptions become more common by database, databases are more useful to econometrics analyses. The author repeats: The current actual statistics data and representative databases always stay at a certain range of corresponding endogenous KEWT database.

Lastly the author referred to Landefeld, S. J., and Fraumeni, B. M. (2009) that calculated each output of non-market goods at households by applying 'Time Use' by country. The KEWT database simultaneously measures national taste and technological progress by country, sector and, year and over years, and distinguishes the macro whole level with the micro partial level. This is because the market rate of interest and an exogenous rate of technological progress are replaced by those endogenous rates.

Conclusively, Chapter 6 broadly compared various original researches and databases with the author's EES and its KEWT. The author's EES is free from record-oriented double-bookkeeping and endowed with its own essence by six nature-neutrals. Uniquely, macro-utility measure is independent of technology and makes it possible to measure capital flow and stock consistently over years in EES.

Roadmap: Towards robust Marginal productivity Theory (endogenous MPT)

Broadly and historically, Roadmap revisits the essence of marginal productivity theory (MPT) and glances at other chapters that discuss an endogenous MPT by aspect.

The MPT has harmonized Keynesians with Neo-classical. The MPT is characterized, based on perfect competition or imperfect oligopoly and duopoly. The MPT connects the individual utility for consumption, without and with the production function. The MPT integrates the literature with author's endogenous system and its KEWT 7.13, where the MPT is regenerated as an endogenous MPT under no assumption.

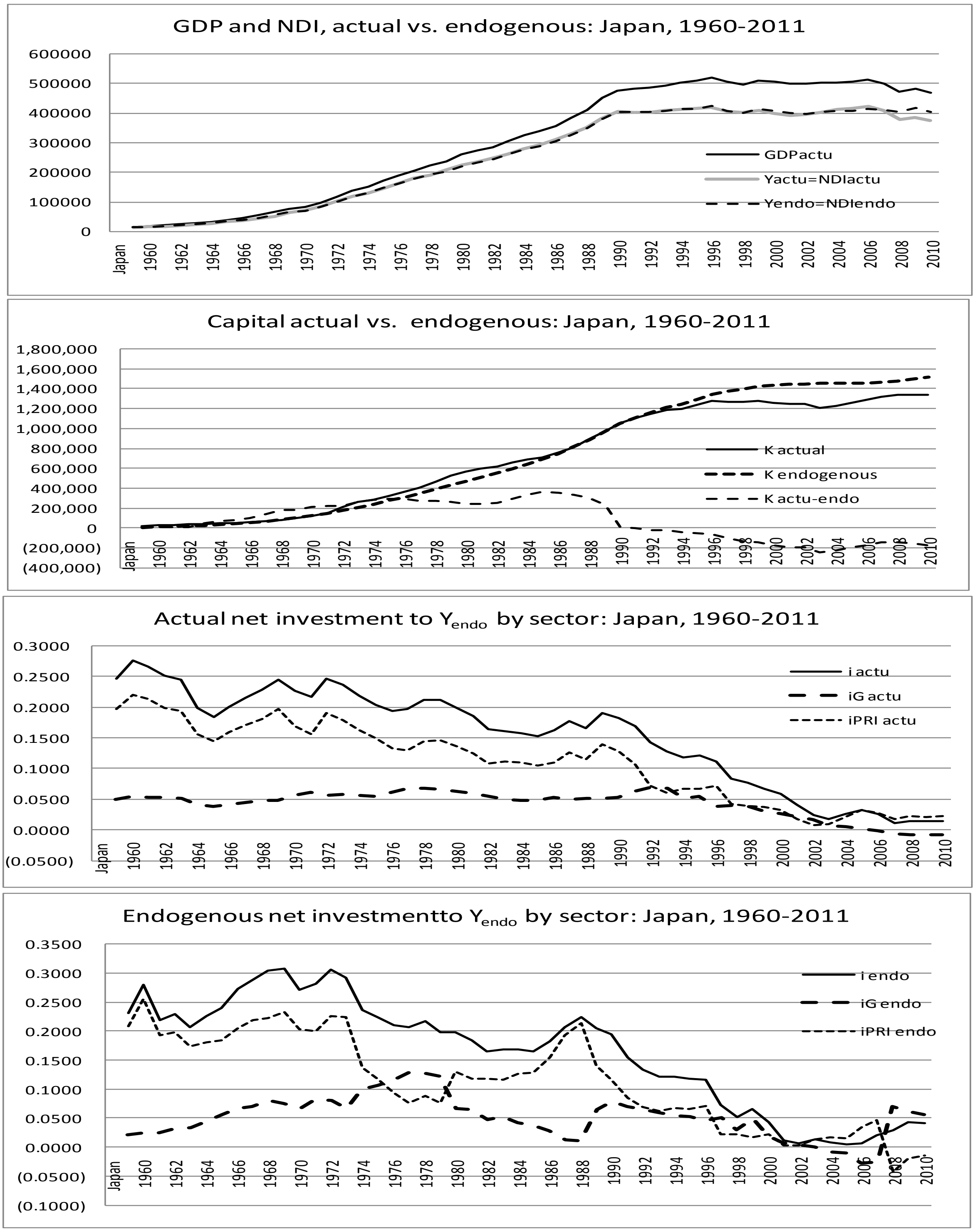
The MPT is always plus and that there exist no extra profits and returns under perfect competition. Marginal rate of substitution (MRS) at the macro level, is overwhelmingly connected with the elasticity of substitution, *sigma*=1.0000000.

MPT was discussed by Keynesians staticly; e.g., Kaldor (309-319, 1992), with assumptions of the steady state, the golden age, and perfect competition. As a result, Pasinetti's (318, ibid.) equation of the rate of profits, $\rho = g/s_c$, holds. A rescue is Kaldor's (1978) stylized facts, typically a constant capital-output ratio. Contrarily, neo-classical uses a continuous Cobb-Douglas or CES production functions, respectively with required assumptions. Neo-classical formulates various equations at the C-D production function, using an external interest rate and an exogenous rate of technological progress. As a result, neo-classical proves actual results by country over years.

Chapter 6

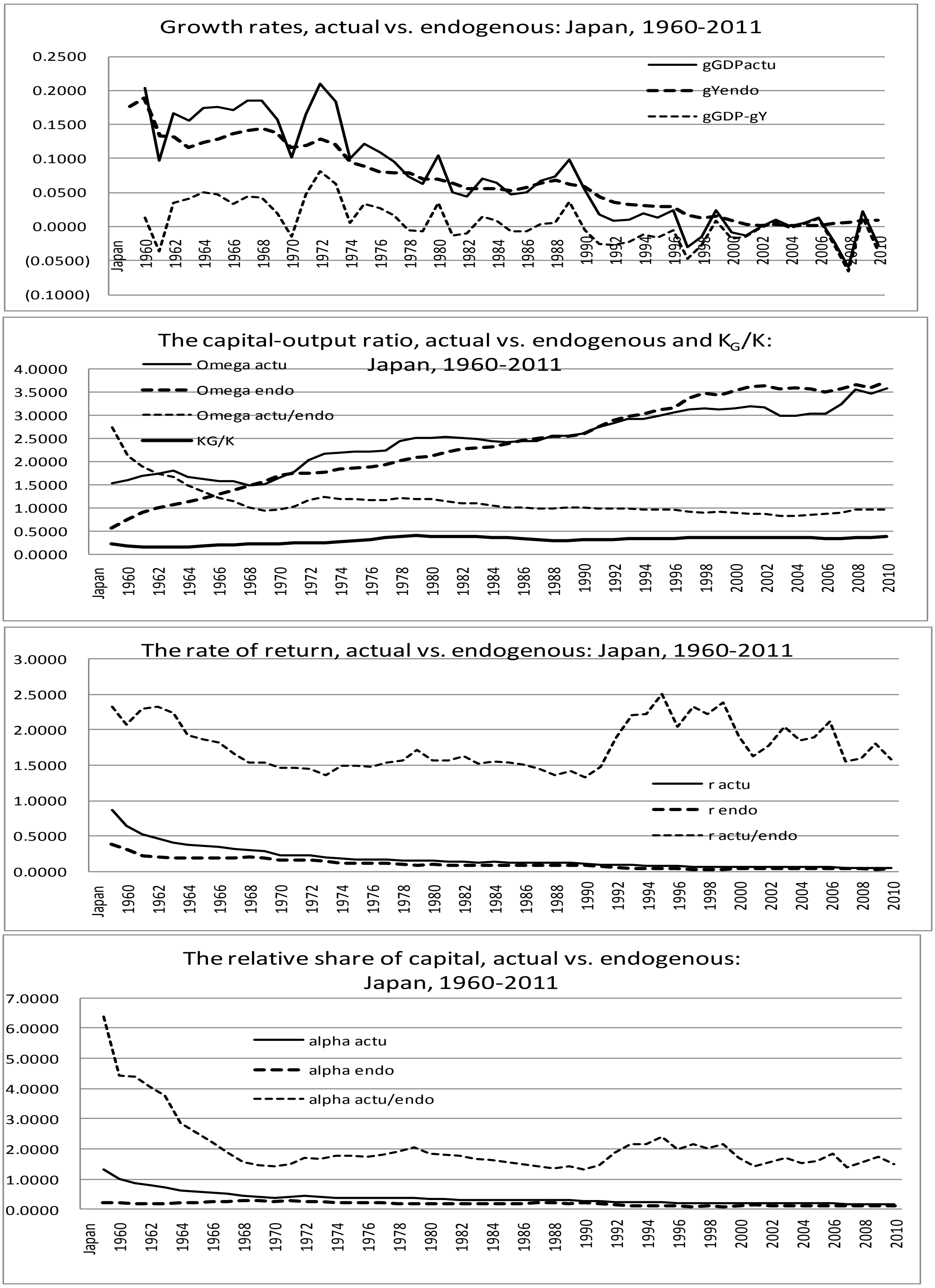
Contrarily the endogenous MPT recovers a whole of extension. The endogenous MPT starts with Samuelson's constancy of the capital-output ratio. The endogenous MPT proves $\Omega = \Omega^* = \Omega_0$ and $\mathrm{r} = \mathrm{r}^* = \mathrm{r}_0$, under CRS and, with diminishing returns to capital (no increasing) under constant returns to scale (CRS). Besides, endogenous ratios each solve problems by aspect. For example, the cost of capital, the speed years, two fiscal multipliers and the size of government are involved in the endogenous MPT (see C5, C7, C12, and C13, consecutively by chapter).

<u>For readers' convenience: contents of figures hereunder</u>



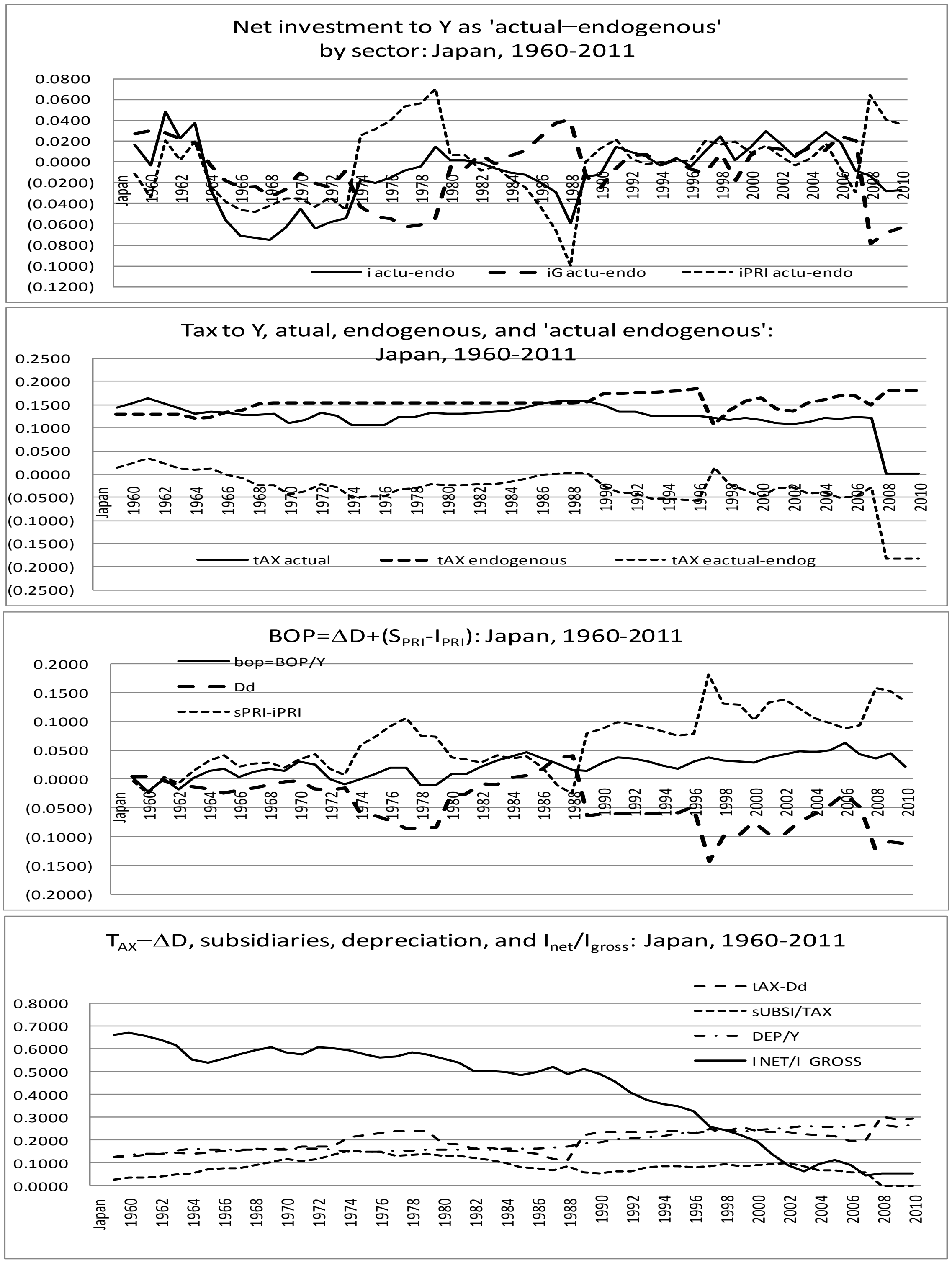
Data sources: KEWT 7.13-6 and related data-sets (the same hereunder)

Figure 1 Capital stock and output, actual and endogenous by sector: Japan, 1960-2011



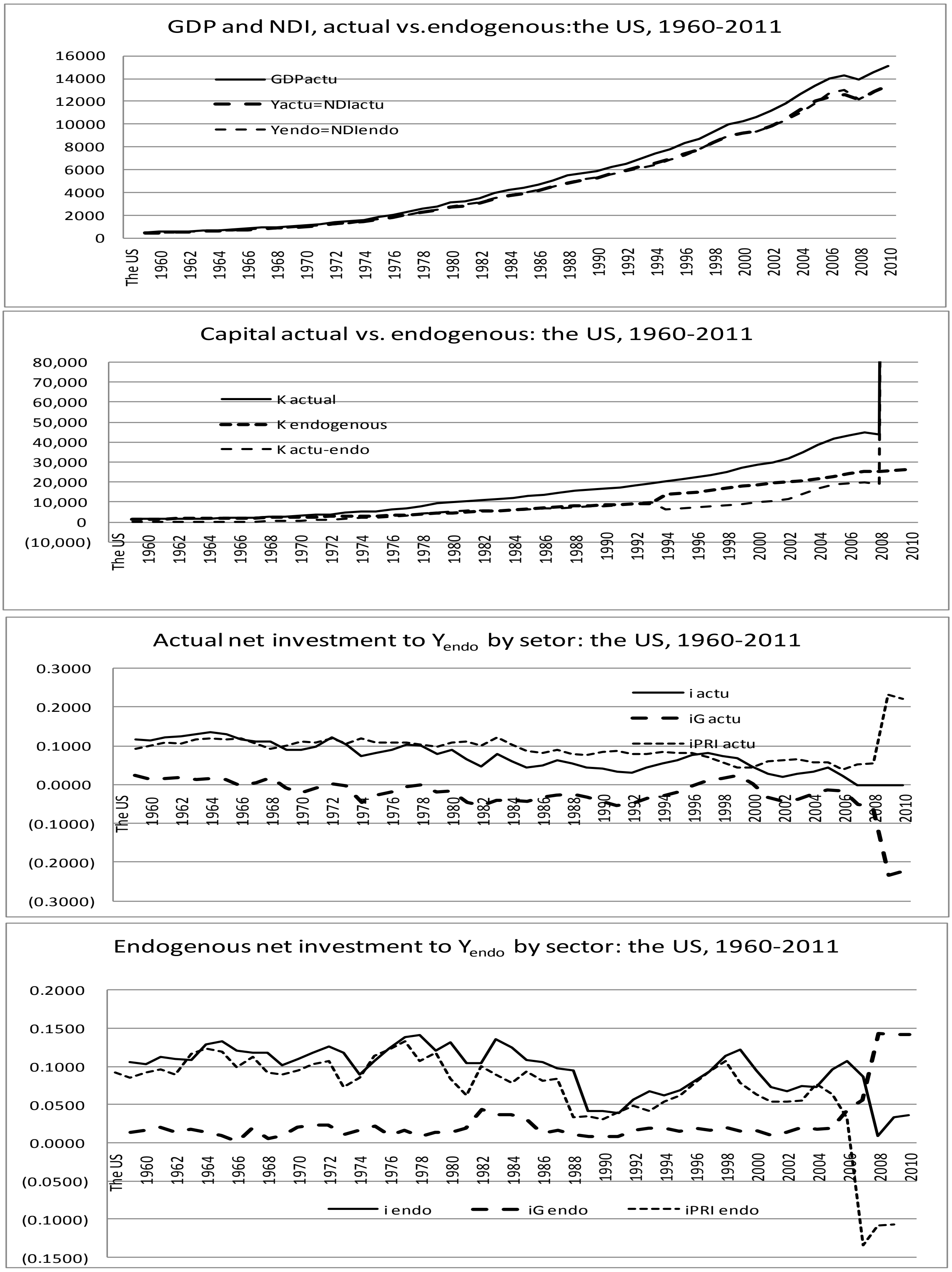
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 2 Structural ratios, actual and endogenous: Japan, 1960-2011



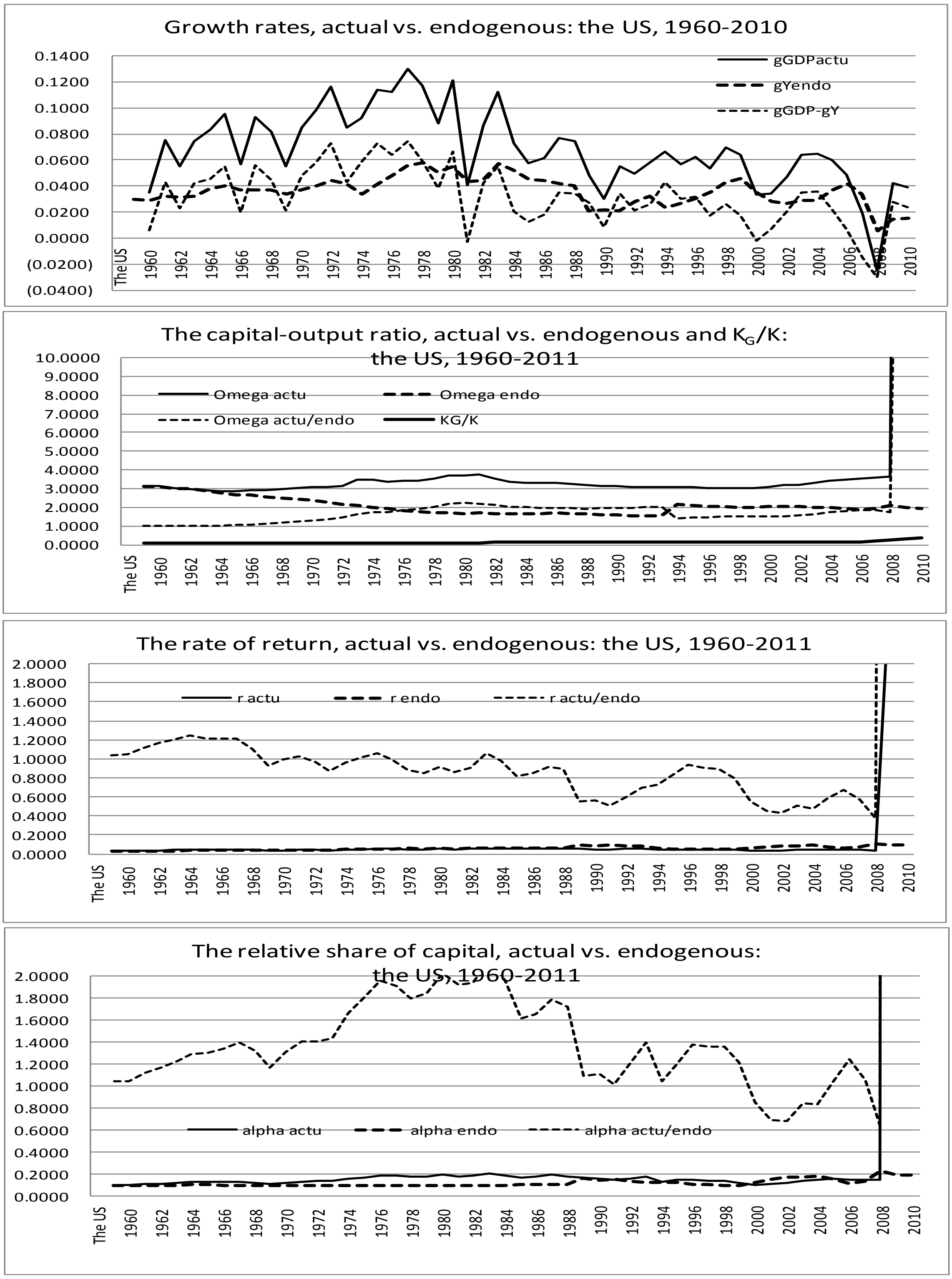
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 3 Net investments by sector and the structure of the BOP, deficit, and taxes, actual and endogenous: Japan, 1960-2011



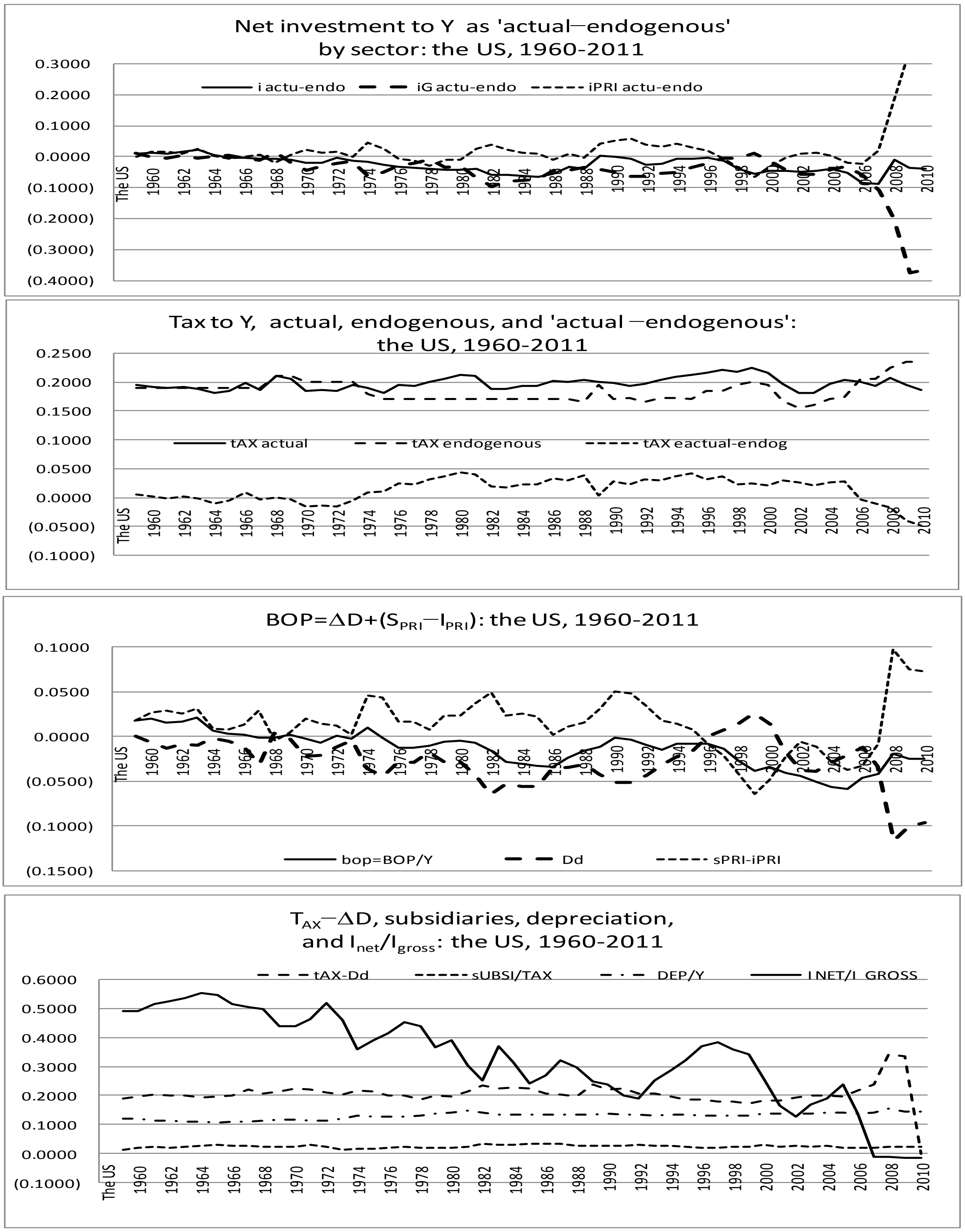
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 4 Capital stock and output, actual and endogenous by sector: the US, 1960-2011



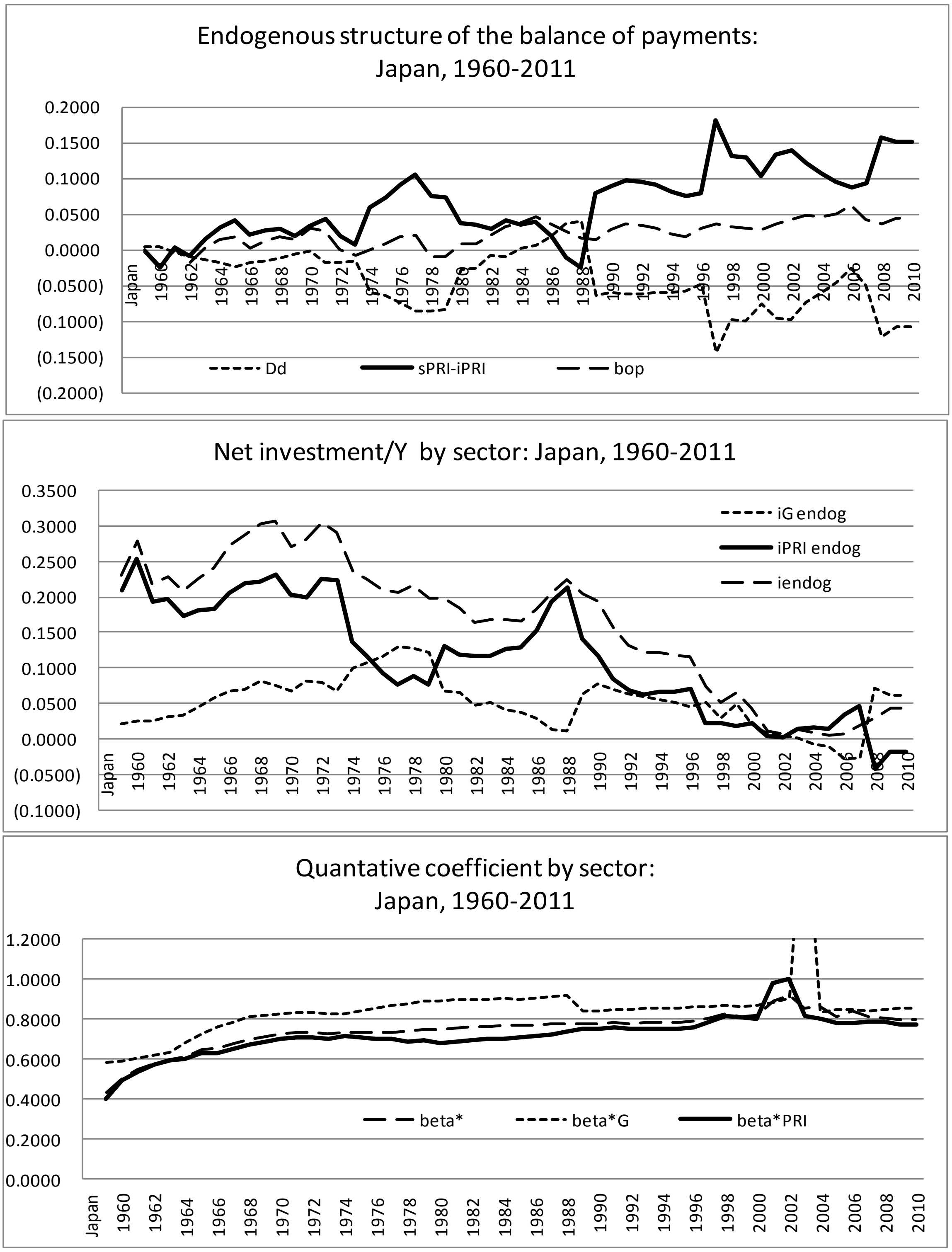
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 5 Structural ratios, actual and endogenous: the US, 1960-2011



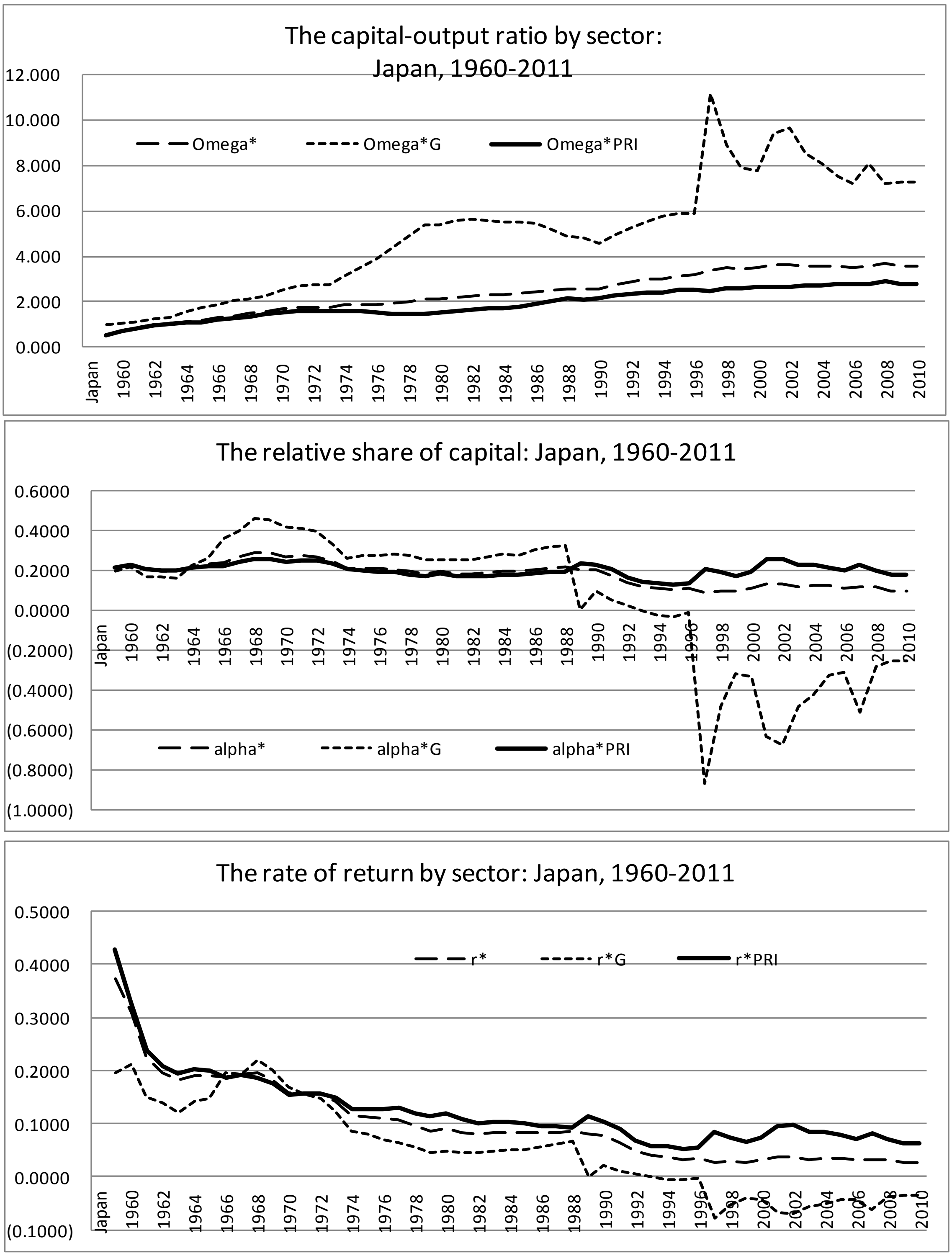
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 6 Net investment by sector and the structure of the BOP, deficit, and taxes, actual and endogenous: the US, 1960-2011



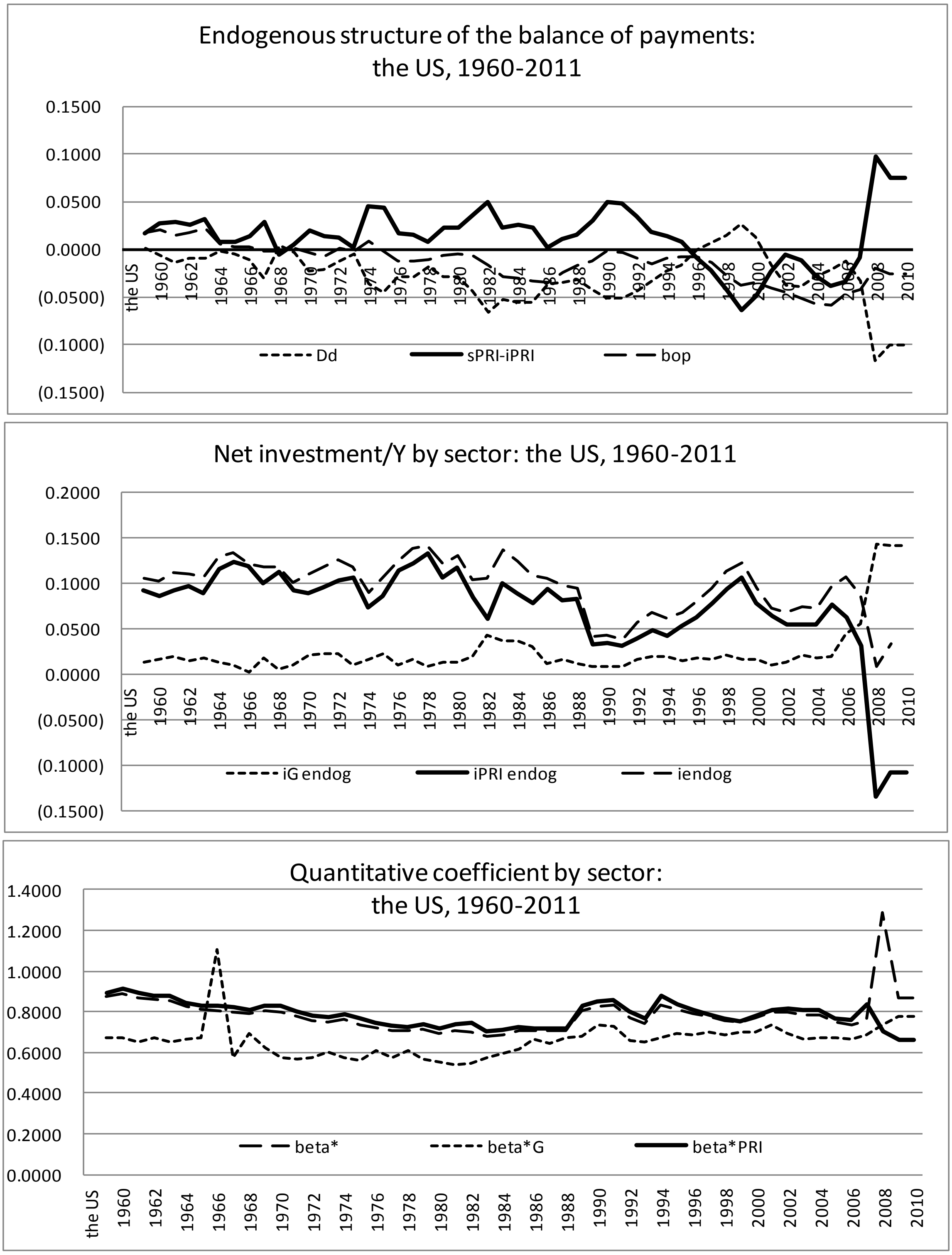
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 7 Policy-oriented structural ahead-ratios, *bop*, $i = I/Y$, β^*, by sector, 1960-2011: Japan



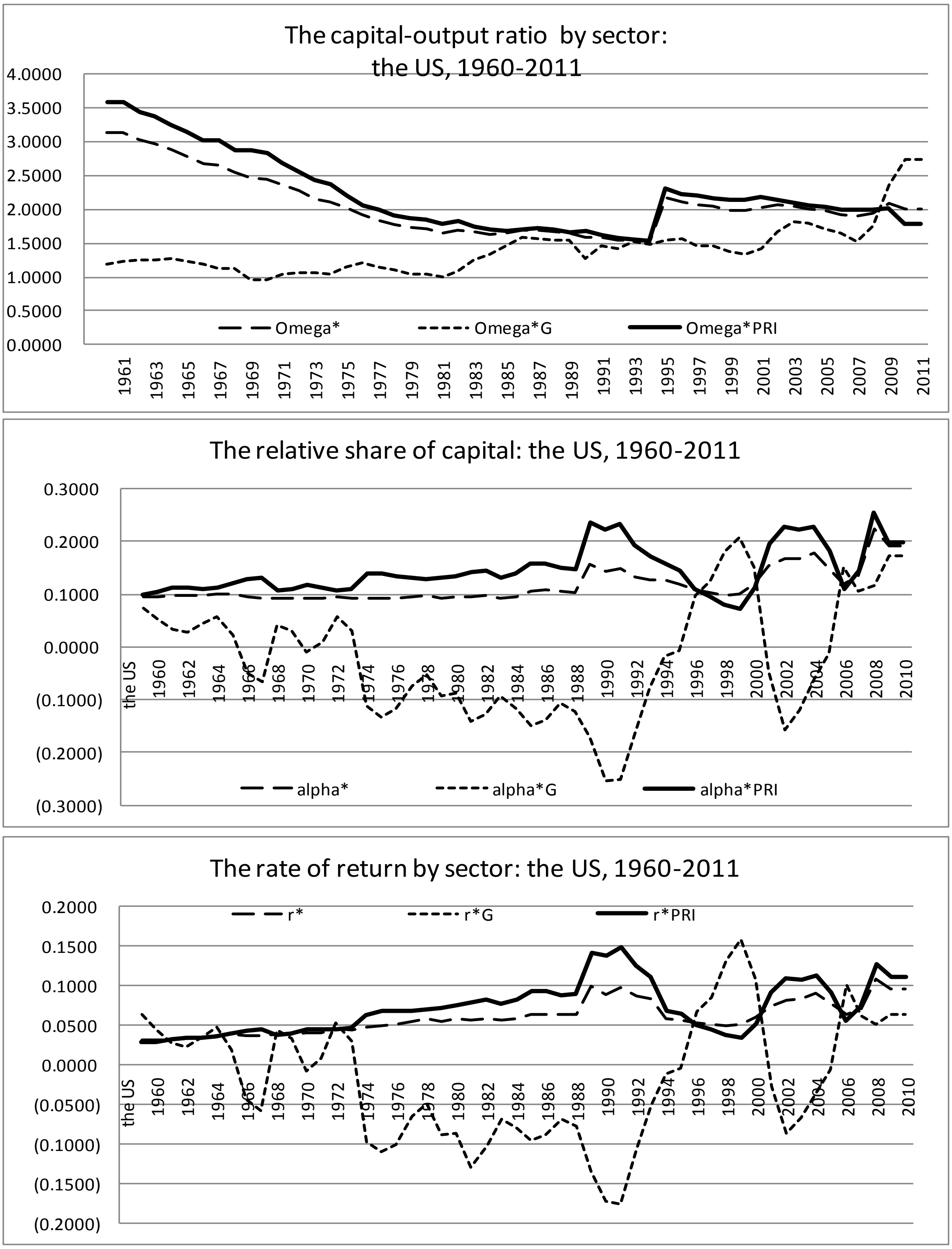
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 8 Policy-oriented structural ratios, $\Omega = K/Y,\ \alpha = \Pi/Y,\ r = \Pi/K$, by sector, 1960-2011: Japan



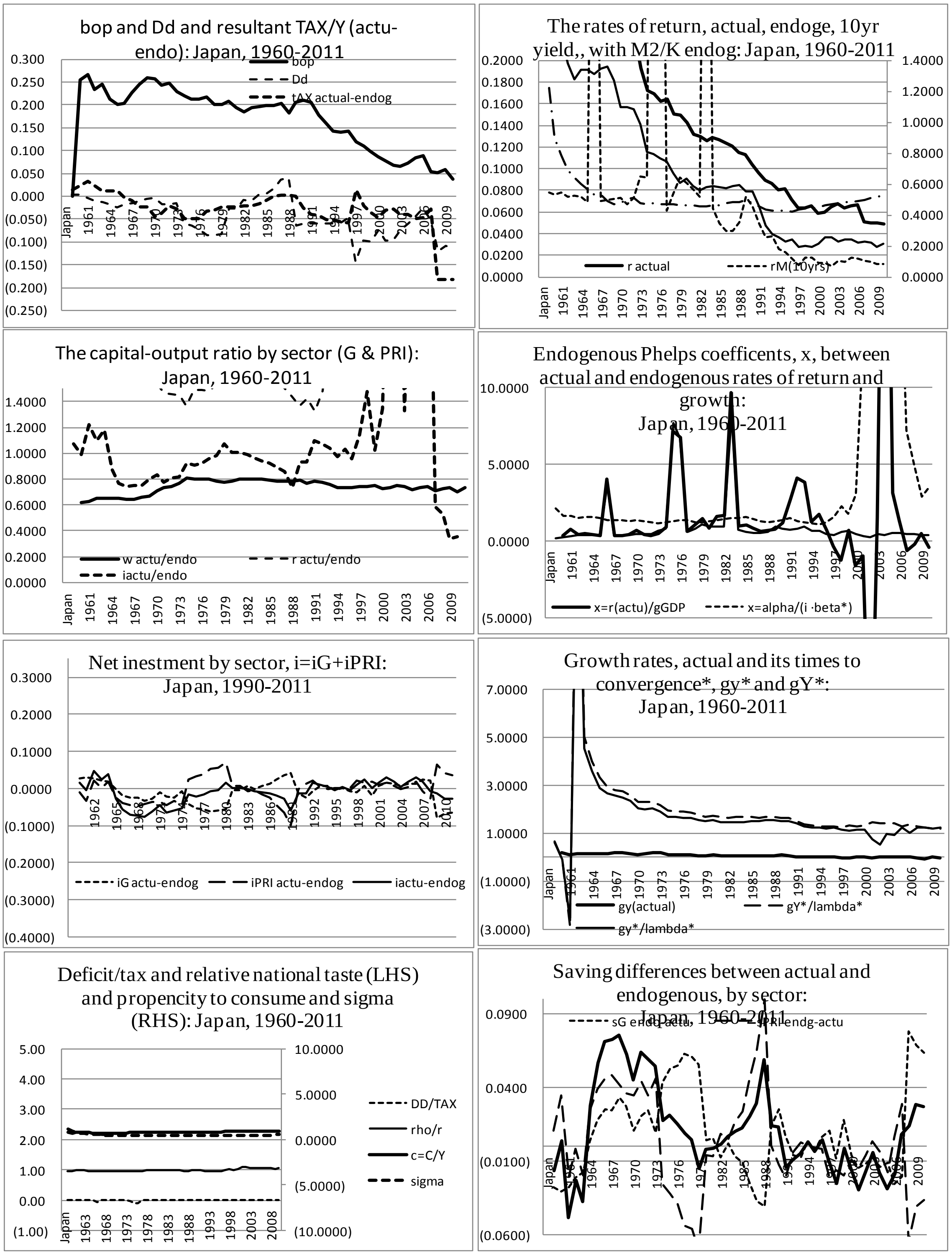
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 9 Policy-oriented structural ahead-ratios, *bop*, $i = I/Y$, β^*, by sector, 1960-2011: the US



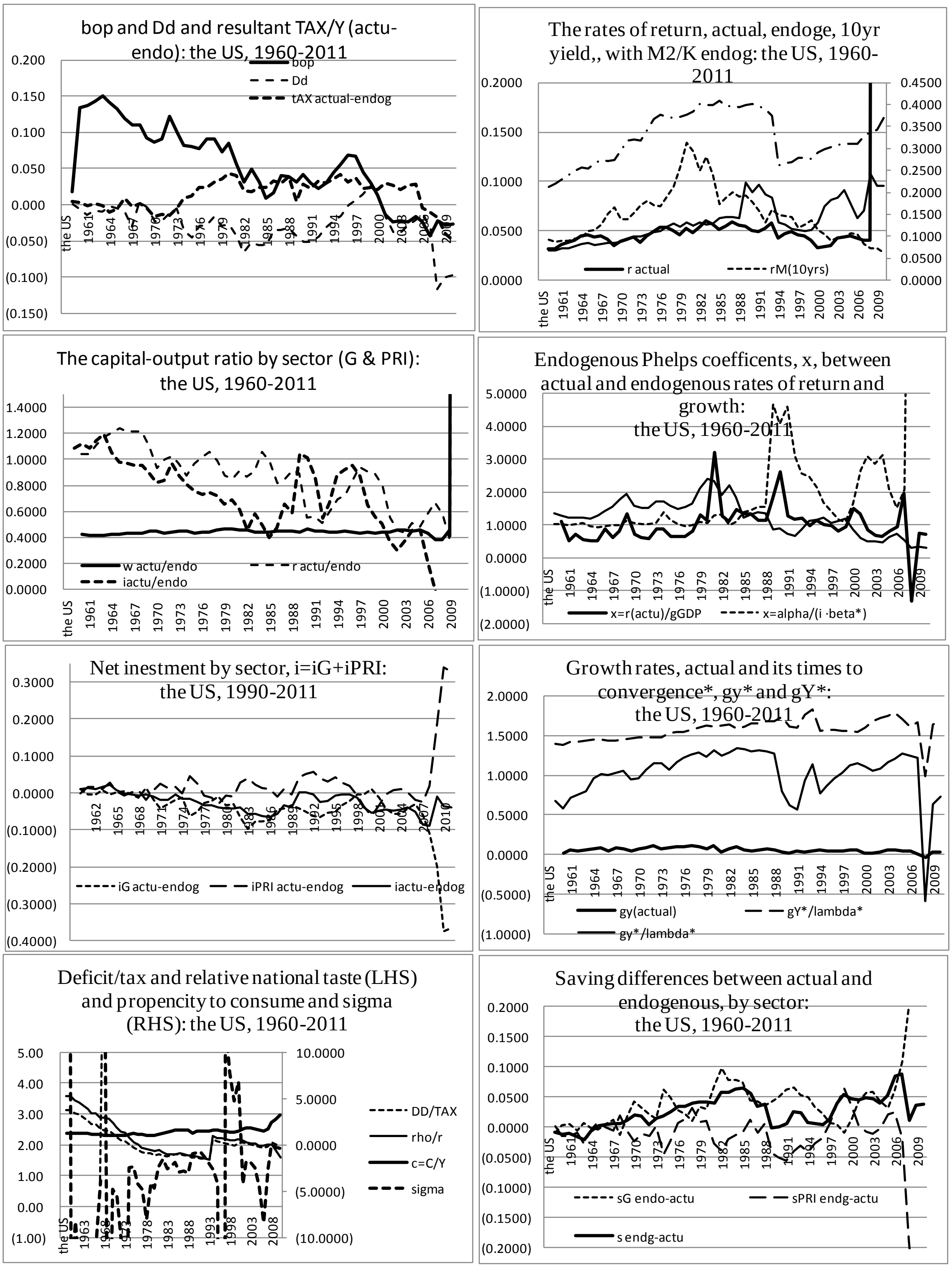
Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 10 Policy-oriented structural ratios, $\Omega = K/Y,\ \alpha = \Pi/Y,\ r = \Pi/K$, by sector, 1960-2011: the US



Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 11 Endogenous and actual/market ratios broadly supporting capital stock: Japan, 1960-2011



Data sources: KEWT 7.13-6, 1960-2011, by sector

Figure 12 Endogenous and actual actual/market ratios broadly supporting capital stock: the US, 1960-2011

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