The Stabilizing Behavior of Households in Aggregate Fluctuations: A Comparison between Japan and the United States

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I. Introduction

Interests in the behavior of households in the context of aggregate fluctuations seem to have been mounting. Benhabib, Rogerson and Wrights (1991) and Greenwood and Hercowitz (1991) have introduced household production into their real business cycle model of the U.S. economy and improved the performance of their respective models along several dimensions mainly by letting the household sector absorb the fluctuations in wage employment. Whereas, Maruyama and Kang (1994,1995) have studied the behavior of an economy including self-employment where employers offer a higher than equilibrium rate of wage to use the resulting excess supply of labor as a worker discipline device (see Shapiro and Stiglitz,1984; Bulow and Summers,1986) .They have verified by formal analysis that employment of the household sector proves to be countercyclical while the relative price of this sector so procyclical (see Schultz,1945; Hart and Kenen,1948) as to cause the substitution of household procuction for purchased goods and services during recession while the substitution the other way round during expansion (see Ghez and Becker,1975). Since household produciton needs some inputs purchased from other sectors, the substitution of this type tends to moderate fluctuations in the demand for goods and services produced by them.

Actually, the notion of the household sector moderating aggregate fluctutaions both in terms of employment and demands for goods and services dates long back. Umemura(1963) examind the monthly fluctuations in classes of Japanese working age population to find that both the number of persons not in labor force but engaged in household production and the sum of self-employed and unpaid family workers were countercyclical. Furthermore, Lebergott(1964) compiled an annual series of American labor force for the period 1900 to 1960, which clearly indicated the countercyclical fluctuations of the sum of self- employed and unpaid family workers. On the other hand, Grossman (1973) examined the effects of unemployment on the relative expenditures on different consumer goods and services to find that households with unemployed members reduce the expenditures which are close substitutes in household production for time of the unemployed. His study indicates that households substitute home produced for purchased goods and services during recession, while purchased for home produced ones during expansion. This paper attempts to examine recent aggregate data of employment and output in Japan and the United States to check whether the household sector tends to moderate aggregate fluctuations both in terms of employment and demands for goods and services.

Series of original data are seasonally adjusted and detrended by use of the Hodrick-Prescott filter(Prescott, 1986; Danthine and Donaldson,1991). Then it is found that quarterly fluctuations in the number of persons not in labor force but engaged in household production reveal their negative correlations with those in GDP both in Japan and in the United States. Fluctuations in the sum of self-employed and unpaid family workers, and persons not in labor force are estimated to absorb more than five times in Japan and nearly 40% as much fluctuations as absorbed by those in the number of unemployed workers. On the other hand, quarterly fluctuations in the household expenditures for consumer services and nondurables exhibit a smaller amplitude as measured in the normalized standard deviation than those in GDP in the two countries, hence they combine with their large shares to moderate fluctuations in the latter. Furthermore, fluctuations in the government capital formation in Japan and the expenditures for national defence in the United States as well as those in imports in the two countries prove to be negatively correlated with those in GDP, hence they are inferred to stabilize fluctuations in the latter.

The following section reviews the analytical framework underlying the present project. Section III analyzes the comovements or covariations between individual sectors of GDP, while Section IV those between individual classes of the working age population. Section V concludes the paper.

II. The Analytical Framework

A simple model of an economy including self-employment will be introduced, the examination of short-term fluctuations in which is the main theme of the present project. There are m identical households and n identical firms, where firms offer a higher than equilibrium rate of wage to use the resulting excess supply of labor as a worker discipline device. Opportunities of employment within the households are somewhat elaborated and the rationing of wage employment by firms as a whole is explicitly specified at the cost of suppressing other features of the original formulation due to Shapiro and Stiglitz(1984). A part mq of the output my_1 of households is consumed by their own members and the remainder nN is provided to firms for one of their inputs. Its price is denoted by p.

$$my_1 - mq - nN \geqq 0, p \geqq 0 \qquad (1)$$

A part mK of the output ny_2 of firms is provided to households for one of their inputs into their household production or family enterprise, and the remainder I is used for investment which is assumed to be autonomous for simplicity. Its price is denoted by r.

$$ny_2 - mK - I \geqq 0;\ I > 0, r \geqq 0 \qquad (2)$$

Labor is supplied by households in the amount Ls, while firms offer a higher than equilibrium rate w of wage and limit their employment n M so as to leave sufficient excess supply of labor as a worker discipline device. They will not lower their rate if there remain some workers willing to work at a lower rate, lest such a rate should undermine their disciplinary purpose. (See,e.g., Shapiro and Stiglitz, 1984; Bulow and Summers,1986.) Otherwise, they behave as price takers. Hence, households are obliged to put all their excess supply of labor into their own household production or family enterprise.

$$mLs \leqq nM, w > 0 \qquad (3)$$

The output y_1 of each household is a well-behaved function of the employment L of its own labor and another input K provided by firms, while the output of each firm is a similar function of the employment M of wage labor and another inputs N provided by households. It is assumed for simplicity that the input of other factors including capital stock fails to affect the level of either output since there remains a considerable idle capacity of them.

$$y_1 = F(L,K),\ y_2 = G(M,N)$$

Each household is a price taker and organizes its production so as to maximize its welfare W, which is a well-behaved function of the consumption of leisure e and a part q of its own output.

$$W = U(e,q)$$

It is subject to the constraints of its budget as well as of its wage employment (3) above.

$$pQs + wLs - rK \leqq 0;\ Qs \equiv F(.) - q,\ Ls = T - L - e \qquad (4)$$

where T denotes the endowment of time per household.

The Kuhn-Tucker-Lagrange conditions of optimality associated with its maximization require the following relations along with the inequalities (3) and (4) above.

$$pF_1(L,K) - w^* \leqq 0,\ w^* = w(1 - \mu / \lambda) \qquad (5)$$

$$pF_2(L,K) - r \leqq 0 \qquad (6)$$

$$U_1(e,q) - \lambda w^* \leqq 0,\ w^* = w(1 - \mu / \lambda) \qquad (7)$$

$$U_2(e,q) - \lambda p \leqq 0 \qquad (8)$$

Here, a new variable w* can be thought of as an internal rate of wage which induces its employment L of labor to equilibrate with its supply T-e in excess of wage employment. Since the inequalities(5)～(6) directly associated with its organization of production share the endogenous variable w* with the inequalities(7)～(8) directly associated with its choice of cunsumption, the system of inequalities (3)～(8) are indecomposable or nonrecursive(e.g., Sasaki and Maruyama, 1965; Jorgenson and Lau, 1969) in the sense that its production organization and its consumption choice are to be jointly determined. The indecomposability of this system has significant effects on its comparative statics. The income effect and others inherent to its consumption choice creep into its production organization to render both its demand for inputs and its supply of output less elastic. In extreme cases they give rise to upward-sloping demand and downward-sloping supply curves. See,e.g.,Maruyama(1984) and Singh, Squire and Strauss(1986). On the other hand, each firm organizes its production so as to maximize it residual profit $\pi_2 = rG(.)-wM-pN$. Therefore,

$$rG_1(M,N) - w \leqq 0 \qquad (9)$$

$$rG_2(M,N) - p \leqq 0 \tag{10}$$

For an interior solution the relation (5) above implies that the marginal revenue product of labor falls short of the market rate of wage in households, while it coincide with the market rate in firms as shown in the relation (9).

$$pF_1(.) = w^* = w(1 - \mu / \lambda) < w = rG_1(.) \tag{11}$$

Thus, the shortage of wage employment due to the disciplinary practice of firms expresses itself in the form of wage differential but not of unemployment as is the case with conventional Keynesian models. From the relations (7) and (8) it follows that the supply rate of wage pU_1/U_2 is below its market rate in households,

$$pU_1(.)/U_2(.) = w^* = w(1 - \mu / \lambda) < w \tag{12}$$

Therefore, they sill seek wage employment at the rate of wage lower than its market rate.

Since investment is assumed to be autonomous, we can change it artificially to generate fluctuations in aggregate demand through a kind of multiplier effect and examine the responses of individual sectors. This task can be carried out by the comparative statics analysis of the system of relations (1) ~(10) above for interior solutions. The Jacobian A of this system does not vanish as shown in Appendix 1 in case both leisure and the output of households are normal goods and firms are competitive with no residual profit imputed. Let us assume that such is the case ,then the comparative statics relations can be solved uniquely for changes in structural variables. A list of formal solutions will be enumerated to give a brief overview of them, where C denotes the bordered Hessian of the relations (3)~(8).The responses of firms are clear-cut to changes in aggregate demand due to changing investment, since the output effects $\eta_r(M)$ and $\eta_r(N)$ as well as the substitution effects $\eta_p(M)$ and $\eta_p(N)$ are of definite sign. Whereas the responses of households involve besides the regular output and substitution effects the income effect and others that are counteractive to the former, hence their responses are generally indeterminate. Nonetheless in case both firms and households are competitive with no residual profit imputed and their technology (welfare function) is of the Cobb- Douglas type, their responses prove to be determinate as shown in the Appendices 2~ 3. Many inequality signs in the following relations are parenthesized to indicate that such cases are addressed in these relations.

A. Employment and output

$$\frac{dM}{dI}A = nG_1C + \eta_r(M)M|G|m\frac{\partial Q_s}{\partial p}C - \eta_p(M)|G|m\frac{\partial Q_s}{\partial r}CF_2 \ (<)\ 0;\ A<0,\ C<0 \quad (13.1)$$

$$\frac{dN}{dI}A = G_1m\frac{\partial Q_s}{\partial M}C + \eta_r(N)N|G|m\frac{\partial Q_s}{\partial p}C - \eta_p(N)N|G|m\frac{\partial Q_s}{\partial r}CF_2 \ (<)\ 0;\ A<0, C<0 \quad (13.2)$$

$$\eta_x(y) \equiv \partial \ln y/\partial \ln x, \quad x = p,\ r,; \quad y = M,\ N; \quad |G| \equiv G_{11}G_{22} - G_{12}G_{21} > 0$$

$$\therefore \ \frac{d}{dI}G(M,N) = G_1\frac{dM}{dI} + G_2\frac{dN}{dI} \ (>)\ 0 \quad (13.3)$$

$$\begin{aligned}\frac{dL}{dI}A = {} & nG_1(\frac{\partial L}{\partial M}C) + nr\eta_r(N)N|G|(\frac{\partial L}{\partial p}C) - nr\eta_p(N)N|G|(\frac{\partial L}{\partial r}CF_2) \\ & - \eta_r(M)M|G|\frac{m\partial^2}{\partial p\partial M}(L,Q_s^*)CF_2 + \eta_p(M)M|G|\frac{m\partial^2}{\partial r\partial M}(L,Q_s^*)CF_2 \\ & - r^2|G|\frac{m\partial^2}{\partial p\partial r}(L,Q_s^*)C \ (>0);\ A<0,\ C<0 \end{aligned} \quad (14.1)$$

$$\begin{aligned}\frac{dK}{dI}A = {} & -nG_1\frac{\partial K}{\partial M}C - nr\eta_r(N)N|G|\frac{\partial K}{\partial p}C + nr\eta_p(N)N|G|\frac{\partial K}{\partial r}CF_2A \\ & + \eta_r(M)M|G|\frac{m\partial^2}{\partial p\partial M}(K,Q_s^*)C - \eta_p(M)M|G|\frac{m\partial^2}{\partial r\partial M}(K,Q_s^*)CF_2 \\ & + r^2|G|\frac{m\partial^2}{\partial p\partial M}(K,Q_s^*)C \ (<0);\ A<0,\ C<0 \end{aligned} \quad (14.2)$$

$$m\frac{d}{dI}F(L,K) = mF_1\frac{dL}{dI} + mF_2\frac{dK}{dI} = n\frac{dN}{dI} + m\frac{dq}{dI} \ (>)\ 0 \quad (14.3)$$

Here, the expression $\partial^2(L,Q_s^*)/\partial p\partial M$ is formed out of the bordered Hessian determinant C, by replacing the two columns corresponding to dL and dK respectively by the two columns representing the coefficients of dp and dM respectively in the comparative statics analysis of the household with respect to the selected variables M, p and r and multiplying it by F_2, then subtracting from it another determinant formed by similarly replacing the two columns corresponding to dL and dq respectively. It should reflect a compound cross effect which changes in wage employment together with those in the output price of households have on the household employment through changes in their marketed surplus Q_s. $\partial^2(L,Q_s^*)/\partial r \partial M$ and $\partial^2(L,Q_s^*)/\partial_p \partial r$ reflect similar effects, while $\partial^2(K,Q_s^*)/\partial p \partial M$ and the like reflect similar compound cross effects on the other input. The relation(14.1) above is consistent with the observations by Umemura(1963) and Lebergott(1964).

$$m\frac{dL}{dI}+n\frac{dN}{dI}=m\frac{d}{dI}(T-e)\ (>)\ 0 \tag{15.1}$$

$$mp\frac{d}{dI}F(L,K)+nr\frac{d}{dI}G(M,N)\ (>)\ 0 \tag{15.2}$$

B. Prices and rates of wage

$$\frac{dp}{dI}A=n r\eta_r(N)N|G|C-r\eta_r(M)M|G|m\frac{\partial Q_s}{\partial M}C-r^2|G|m\frac{\partial Q_s}{\partial r}C\ (<)\ 0;\ A<0,\ C<0 \tag{16.1}$$

$$\frac{dr}{dI}A=-n r\eta_p(N)N|G|CF_2-r\eta_p(M)M|G|m\frac{\partial Q_s}{\partial M}CF_2-r^2|G|m\frac{\partial Q_s}{\partial r}C\ (<)\ 0\ ;\ A<0,\ C<0 \tag{16.2}$$

From the relation(6) above in equality

$$\frac{d}{dI}\ln pF_2(L,K)=\frac{d}{dI}\ln r,\ \frac{1}{p}\frac{dp}{dI}+\frac{1}{F_2}\left(F_{21}\frac{dL}{dI}+F_{22}\frac{dK}{dI}\right)=\frac{1}{r}\frac{dr}{dI}$$

$$\therefore\ \frac{1}{p}\frac{dp}{dI}(>)\frac{1}{r}\frac{dr}{dI},\ F_{21}\frac{dL}{dI}+F_{22}\frac{dK}{dI}(<)\ 0 \tag{16.3}$$

This relation has been noticed by many authors including Schultz(1945), Hart and Kenen(1948). Similarly from the relation(5) above in equality,

$$\frac{d}{dI}\ln w^* = \frac{1}{p}\frac{dp}{dI} + \frac{1}{F_1}(F_{11}\frac{dL}{dI} + F_{12}\frac{dK}{dI})(>)\frac{1}{p}\frac{dp}{dI}(>)\frac{1}{w}\frac{dw}{dI} = 0, \qquad (17.1)$$

$$F_{11}\frac{dL}{dI} + F_{12}\frac{dK}{dI}(>) 0$$

$$\frac{d}{dI}\ \{(mw^*L+nwM)/(mL+nM)\}\ (>) 0,\ w^* < w \qquad (17.2)$$

From the same relation(5) in equality,

$$\frac{d}{dI}\ln(w\text{-}w^*) = \frac{d}{dI}\ln(w\mu/\lambda)$$

$$\frac{1}{w-w^*}\ \{-\frac{dp}{dI}F_1(L,K) - p(F_{11}\frac{dL}{dI} + F_{12}\frac{dK}{dI})\}\ (<)0,\ F_{11}\frac{dL}{dI} + F_{12}\frac{dK}{dI}\ (>) 0 \qquad (17.3)$$

This result coincides with the observations by Taira (1970) and Okun (1981).

C. Consumption, marketed surplus and supply of labor

$$\frac{de}{dI}A = nG_1(\frac{de}{dM}C) + n\eta_r(N)N|G|(\frac{de}{dp}C) - n\eta_p(N)N|G|(\frac{de}{dr}CF_2)$$

$$- \eta_r(M)M|G|\left\{\frac{m\partial^2}{\partial p\partial M}(e,Q_s)C\right\} + \eta_p(M)M|G|\{\ \frac{m\partial^2}{\partial r\partial M}(e,Q_s)CF_2\ \}$$

$$- r^2|G|\left\{\frac{m\partial^2}{\partial p\partial r}(e,Q_s)C\right\}(>)0\ ;A<0, C<0 \qquad (18.1)$$

$$m\frac{dL_s}{dI} = m\frac{d}{dI}(T-L-e) = n\frac{dM}{dI}\ (>) 0 \qquad (18.2)$$

$$\frac{dq}{dI}A = nG_1\frac{\partial q}{\partial M}C + n\eta_r(N)N|G|\frac{\partial q}{\partial p}C - n\eta_p(N)N|G|\frac{\partial q}{\partial r}CF_2 + \eta_r(M)M|G|\frac{m\partial^2}{\partial p\partial M}(q,Q_s^*)C$$

$$-\eta_p(M)M|G|\frac{m\partial^2}{\partial r\partial M}(q,Q_s^*)CF_2+r^2|G|\frac{m\partial^2}{\partial p\partial r}(q,Q_s^*)C\ (<)\ 0\ ;A<0,C<0 \quad (19.1)$$

$$\therefore\ m\frac{dQ_s}{dI}=m\frac{d}{dI}\ \{F(L,K)-q\}\ =n\frac{dN}{dI}\ (>)\ 0 \quad (19.2)$$

These results suggest for the case of Cobb-Douglas technology(welfare) that aggregate employment, aggregate output, price level, and average rate of wage comove or covary with investment or demand for the firm sector. So do employment and output of the firm sector, while employment of the household sector countermove or countervary against demand for the firm sector. Both price and wage rate of this sector fluctuate more widely than their counterparts of the other sector, suggesting that its output and demand for inputs fluctuate less widely or in the other direction than their counterparts. The wage rate of firm sector remains invariant due to the simplified formulation of labor market, hence wage labor can be regarded as a numeraire in the present model. Thus, the wage differential between the two sectors countermove or countervary against demand for the firm sector. Therefore, in relative terms the firm sector simulates the fixprice(flexemployment-output)economy, while the other the flexprice(fix or countercyclical employment-output)one(Hicks,1965; Morishima,1976). All these results reproduce fairly well the stylized behavior of the economy of this type as observed by Schultz(1945), Hart and Kenen(1948), Umemura(1963), Lebergott(1964), Taira(1970), Okun(1981) , Grossman(1973), Ghez and Becker(1975).

Ⅲ. Secular Trends and Quarterly Fluctuations of the GDP Sectors

Quarterly data of the Japanese economy from 1971.1 to 1993.3 are adapted from the Annual Reports on National Accounts (Economic Planning Agency of Japan, 1971 to date). Data disaggregated at the current level started to be published around 1970. These data are deflated at 1990 yen and seasonally adjusted. Similar data of the U.S. economy from 1976.3 to 1997.2 are adapted from the National Income and Product Accounts (Bureau of Economic Analysis, U.S. Department of Commerce, 1976 to date) through PDG at the University of Maryland. Data of this period are chosen because a combined analysis of the NIPA data and those of the working age population is intended in this paper and the corresponding data of the latter are available in the United States only since the third quarter of 1976 (see Bureau of Labor Statistics, U.S. Department of Labor, 1976 to date). These data are deflated at the chained 1992 dollar and seasonally adjusted.

Household consumption expenditures constitute an extremely large part of GDP, i.e., its 59% in Japan and 67% in the United States and include a variety of expenditures. Hence, they are further disaggregated into a number of types, i.e., durables (and semidurables in Japan), nondurables, and services (and others in Japan), since the first are very different from others and can more appropriately be thought of as capital formation on the part of households (see, e.g., Eisner, 1989; Greenwood and Hercowitz, 1991). The sum of consumer services, nondurables and others accounts for 48% in Japan, while 59% of GDP in US, suggesting that US consumers have a much higher propensity to consume than Japanese consumers. On the other hand, the sum of consumer durables and semidurables, and residential investment in US (household equipment and structures in Japan) accounts for 12% in US while 20% of GDP in Japan, suggesting that Japanese consumers have a much higher "propensity to invest" than US consumers. Furthermore, it exceeds the sum of business equipment and structures in the respective countries which amounts to 10% in US and 14% of GDP in Japan (see Tables 1.1 and 1.1.a), which in turn suggests a higher capital intensity of the household sector than that of business sector since the former employs 45% in US and 53% of the working age population in Japan while the latter employs its 46% in US and 45% in Japan (see Tables 1.3 and 1.3.a).

Then these series of data are detrended by means of the Hodrick-Prescott filter (Prescott, 1986; Danthine and Donaldson, 1991). For the value of Lagrange multiplier λ of the smoothness constraint, 800, 1600, 3200, and 6400 are tried. The value of 1600 is chosen since it gives rise to detrended series of interest for all sectors in the sense that they share comovements or covariations of various signs. See Tables 1.2, 1.2.a, 2.1 and 2.1.a. On the whole US series of data are more highly autocorrelated than Japanese counterparts. Among Japanese series, business equipment and structures, and imports are highly autocorrelated, while consumer nondurables, government expenditures and change in inventories are hardly autocorrelated. On the other hand among US series, consumer services and nondurables, residential investment, business equipment and structures, exports and imports are highly autocorrelated, while change in inventories, national defense and government expenditures are less highly autocorrelated. As for their rate of growth, Japanese series by and large exhibit higher rates than US counterparts. Among Japanese series, consumer durables exhibit the highest rate, i.e., more than twice as high as that of GDP, being followed by exports and business equipment, while business structures, government equipment and structures very low rates. Among US series, government equipment, exports, imports, and business equipment exhibit very high rates, i.e., more than twice as high as that of GDP being followed by consumer durables, while change in inventories and national defense very low rates.

On the other hand, in regard to their volatility these two sets of series look very similar. Change in inventories exhibits by far the highest volatility as measured in terms of their normalized standard deviations being followed by expenditures of nonprofit institutions, business structures and three sectors of government investment in Japan and by residential investment, government structures, and business equipment and structures in US. Whereas, consumer services and nondurables, and government expenditures exhibit lower volatility than GDP. Since they have large shares in GDP, i.e., 71% in US and 57% in Japan, they tend to moderate aggregate fluctuations.

Furthermore, the normalized standard deviations of the sum of consumer durables and residential investment in US and the similar sum of consumer durables and semidurables, and household equipment and structures in Japan respectively fall short of the corresponding standard deviations of the sum of business equipment and structures, and change in inventories, hence they add less to aggregate fluctuations than the latter in the two countries.

Now, the structure of comovements or covariations between these series of data will be examined. Estimates of their correlations in the two countries are shown respectively in Tables 2.1 and 2.1.a. It is noteworthy that these tables are interspersed with a considerable number of negative coefficients as many as 43% in Japan and 32% of all in US. These negative coefficients of correlation suggest the presence of counteractive movements or variations which moderate variations initiated in the corresponding sectors therefore tend to stabilize aggregate fluctuations. Since business equipment has a very large variance measured in original unit around its Hodrick-Prescott trend to have a great effect on aggregate fluctuations in Japan, it may be advised to examine somewhat closely the structure of covariations with special reference to its variations and those of GDP. A similar examination of the corresponding US structure is made mainly for the sake of comparison. Major results of these efforts are summarized respectively in Tables 1.2 and 1.2.a.

Japanese imports and three sectors of government investment are negatively correlated with business equipment, so are expenditures of governments and nonprofit institutions, and household structures to a lesser degree. Whereas, business structures, consumer services, durables and semidurables, and household equipment are positively correlated. Therefore, variations in business equipment are reduced by those in the former group of sectors while enlarged by the latter group, then its variations thus transformed will be added to those in GDP. On the other hand, imports and government structures are negatively correlated with GDP, while business equipment and structures, consumer durables and semidurables, consumer services, nondurables and others are positively correlated. Thus, the presence of the built-in stabilization by imports and the effect of countercyclical policy by the Japanese government are suggested. US imports and national defense are negatively correlated, while all other sectors are positively correlated with business equipment. These two sectors are also negatively correlated with GDP. Hence the presence of the built-in stabilization by imports and the effect of countercyclical expenditures for national defense are suggested.

In order to make a more exact accounting of variations and covariations, a linear estimate of secular trends is attempted at the conscious sacrifice of several merits provided by the Hodrick-Prescott filter, so that covariances of the deviations of each sector from its secular trend with similar deviations of other sectors add up to its similar covariace with GDP.

$$\Sigma_j \mathrm{cov}(dX_{it}, dX_{jt}) = \mathrm{cov}(dX_{it}, dX_{GDPt}), \quad dX_{it} = X_{it} - \tau_{it} \quad \text{for all i,}$$

where X_{it} and τ_{it} denote a series of data and a trend path respectively. To implement the said estimate of secular trends, those of the cubic type are selected in the light of their good performances out of several types tried for this purpose. Since series of data are significantly autocorrelated and since the adding-up property of covariances is desired, they are estimated on the basis of their quasi-first differences and by use of the iterated SUR method with all their coefficients of autoregression assumed to share a common value.

$$X_{it} = \alpha_i + \beta_i t + \ldots + \delta_i t^3 + u_{it},$$

$$X_{it} - \rho X_{i,t-1} = \alpha_i(1-\rho) + \beta_i(t-\rho(t-1)) + \ldots + \delta_i(t^3-(t-1)^3) + \varepsilon_{it}, \quad t \geqq 2 \quad \text{for all i,}$$

where ρ denotes the common coefficient of autoregression. Estimates by use of this method are known to be numerically equivalent to those by the maximum likelihood method. Covariances of business and GDP estimated by this method are appended in the far right columns of Tables 1.2 and 1.2.a.

These covariances naturally do not coincide with those in original unit around the Hodrick-Prescott trends, but they should offer additional information in regard to the structure of aggregate fluctuations. 65% of variations in business equipment are offset by their negative covariations with imports, while other 19 and 5% respectively of them by their negative covariations with three sectors of government investment and expenditures of government and nonprofit institutions. On the other hand, they are enlarged by 29 and 23% respectively by their positive covariations with business structures and change in inventories, and with household equipment and structures. Furthermore, they are enlarged by 38 and 32% respectively by their positive covariations with consumer durables and semidurables, and with consumer services and nondurables. After all their positive and negative covariations being summed up, they add 37% more than their own variations to those in GDP. Whereas, 78% of variations in GDP are accounted for by those in business equipment and structures and change in inventories. Remaining 26 and 22% respectively of them are accounted for by those in consumer durables and semidurables, and in consumer services and nondurables. On the other hand, they are reduced by 39% by those in imports and by other 6.4% by those in the three sectors of government equipment.

In the United States the matter looks very different, probably because the share of business equipment in GDP is 6.5%, less than half that of its Japanese counterpart. Its variations are more than offset by 74% by those in imports and exports, furthermore they are reduced by 6.4% by variations in government expenditures. Whereas, they are greatly enlarged by variations in consumer durables, residential investment, consumer services and nondurables and others. After all these positive and negative covariations they add more than four times as large variations as their own to those in GDP, while 39% of them are accounted for by those in residential investment and consumer durables. Remaining 33 and 16% respectively of them are accounted for by those in consumer services and nondurables and in business equipment and structures, and change in inventories. On the other hand they are reduced by 19% by those in imports.

IV. Secular Trends and Quarterly Fluctuation of the WAP Classes

Quarterly data of the Japanese working population from 1971.1 to 1993.3 are adapted from the Annual Reports on the Labor Force Survey (Statistics Bureau, Japan Management and Coordination Agency, 1971 to date). This period of data is selected to be consistent with that of the GDP data. Persons officially not in labor force are included in the present analysis, since they constitute a very important class of the working age population (WAP for short) and since they are actually engaged in household production both of goods and services and of knowledge and skills. Furthermore, they play an important role of absorbing variations in wage and salary employment over aggregate fluctuations as will be shown below (see also Umemura, 1963). Similar data of the US WAP from 1976.3 to 1997.2 are adapted from the Current Population Survey (Bureau of Labor Statistics, US Department of Labor, 1976 to date) through the home pages of BLS. Data of this period are selected mainly because the data of persons not in labor force classified by sex are not available through these home pages before 1976.3. All these data are classified by sex and seasonally adjusted.

Women not in labor force exceed female wage and salary workers in Japan. But this relation is reversed in US, nonetheless they constitute more than 45% of female WAP. On the other hand male wage and salary workers far exceed men not in labor force in the two countries. Thus it is still true that household production is taken care of mainly by women at home, while men work mainly for wages and salary outside home. Furthermore, the sum of self-employed and unpaid family workers, and persons not in labor force, as it were, family employment or workers exceed the sum of wage and salary workers and unemployment workers. However, this is not the case with US, nonetheless the former used to exceed the latter before 1958. Thus, the present state and history of the WAP indicate the importance of family employment in the two countries. In the past 20 years or so the WAP of the two countries has experienced an extensive structural change. Male self-employed and unpaid family workers, female unpaid family workers and women not in labor force each class of the two countries and female self-employed workers of Japan have registered a negative rate or a positive rate of growth lower than WAP's, while the wage and salary workers of both sexes and men not in labor force each class of the two countries and female self-employed workers of US a positive rate higher than WAP's. Unemployed workers of both sexes have registered the highest rates in Japan, while their US counterparts rates at nearly one-third of WAP's (See Tables 1.3 and 1.3.a).

All these series of data are detrended by means of the Hodrick-Prescott filter. For the value of Lagrange multiplier λ of the smoothness constraint, the value of 1600 is selected for the same reason as in the case of GDP data. Main results of significance are summarized in Tables 1.3, 1.3.a, 1.4 and 1.4.a. On the whole US series of data are more closely autocorrelated than Japanese counterparts, especially those of unemployed, and wage and salary workers are. Others are so to a lesser degree. As for their volatility the WAP's of the two countries are far less volatile than their respective GDP's with their standard deviations (SD for short) being nearly one-tenth of their respective GDP's, while some of their individual classes possess far larger SD's than their respective GDP's. Hence the presence of negative comovements or covariations between them are suggested. Unpaid family workers and unemployed workers of both sexes, female self-employed workers each class of the two countries and male self-employed workers of US possess SD's larger than their respective GDP's. It is noteworthy that wage and salary workers and persons not in labor force of both sexes are relatively stable in the two countries. Male wage and salary workers are the most stable with their SD's being nearly half that of their female counterparts in Japan, while US women not in labor force are the most stable of all WAP classes in the two countries.

Matrices of estimated correlations between individual WAP classes are shown in Tables 2.2 and 2.2.a. As expected, they are interspersed with a great number of negative coefficients as many as 64% in Japan and 56% of all in US. Since wage and salary workers of both sexes possess very large variances in original unit as summarized in Tables 1.3 and 1.3.a, it may be advised to make a closer examination of the structure of covariations with special reference to these classes of workers. Major results of this effort are summarized in Tables 1.4 and 1.4.a. All classes of WAP other than female self-employed and wage and salary workers are negatively correlated with male wage and salary workers in US, while all classes other than female self-employed and wage and salary workers and women not in labor force are negatively correlated with male wage and salary workers in Japan. On the other hand, all classes other than self-employed workers of both sexes and male wage and salary workers are negatively correlated with female wage and salary workers in US, while all classes other than female self-employed and male wage and salary workers are negatively correlated with female wage and salary workers in Japan. Furthermore, all classes other than self-employed and wage and salary workers of both sexes are negatively correlated with GDP and business equipment in US, while unemployed workers and persons not in labor force of both sexes are negatively correlated both with GDP and business equipment in Japan. Thus, the structure of comovements or covariations between individual WAP classes and selected GDP sectors proves to be very similar in the two countries in the sense that variations in wage and salary employment are absorbed by negative covariations in other classes to stabilize aggregate employment over aggregate fluctuations.

In order to make a more exact accounting of variations and covariations, trend paths of the cubic type are estimated. The associated estimates of variances and covariances between individual WAP classes are summarized in reference to wage and salary employment of both sexes in the far right columns of Tables 1.4 and 1.4.a. Variations in Japanese male wage and salary employment are enlarged by 49% by those in its female counterpart, while they are reduced by 86% by those in male family employment, by 54% by those in female family employment other than self-employment, and by other 13% by those in unemployment of both sexes. Whereas, variations in Japanese female wage and salary employment are more than offset by those in female family employment other than self-employment and are reduced by 43% by those in male family employment and by 16% by those in unemployment of both sexes. Thus, variations in female wage and salary employment are absorbed mainly by those in female family employment, while those in its male counterpart are absorbed relatively evenly both by those in male and female family employment in Japan. Therefore, 87% of variations in wage and salary employment are absorbed by those in family employment, while other 10% by those in unemployment, which only amount to nearly one-ninth of the former.

On the other hand, variations in US male employment are more than offset by those in unemployment of both sexes and are reduced by 27 and 18% respectively by those in women and men not in labor force. Similarly, variations in US female wage and salary employment are more than offset by those in unemployment of both sexes, and are reduced by 43 and 24% respectively by those in women and men not in labor force. Thus, the importance of variations in male unemployment and in women not in labor force should be clear in absorbing variations in US wage and salary employment. To sum up, 64% of variations in wage and salary employment are absorbed by those in unemployment, while other 27% by those in family employment which amount to nearly 43% of the former. A relatively small share of these variations absorbed by those in family employment may partly due to the smaller share of US family workers in WAP than the corresponding share of their Japanese counterparts.

The sign structures of the estimated covariances in original unit by means of the Hodrick-Prescott trend and of the cubic trend are very similar in the two countries. However, the numerical values of the former are larger than those of the latter in Japan while the reverse is true in US. Therefore it would be better to compare them carefully especially in reference to variations in wage and salary employment. Variations in US male wage and salary employment in original unit around their Hodrick-Prescott trend are enlarged by 59% by similar variations in its female counterpart, while they are reduced by those in unemployment of both sexes and by other 39% by those in family employment other than female self-employment. Whereas, similar variations in female wage and salary employment are enlarged by 130% by those in its male counterpart, while they are reduced by 124% by those in unemployment of both sexes and by other 62% by those in family employment other than self-employment of both sexes. These variations enlarged or reduced by more than 100% mainly reflect both the greater magnitude and volatility of male wage and salary employment and the greater volatility of unemployment respectively than those of female wage and salary employment. Thus, it is verified that 57% of variations in US wage and salary employment in original unit around their Hodrick-Prescott trends are absorbed by similar variations in unemployment, while other 23% by those in family employment which amount to nearly 40% of the former.

On the other hand, variations in Japanese male wage and salary employment in original unit around its Hodrick-Prescott trend are enlarged by 40% by similar variations in its female counterpart, while they are reduced by 76% by those in family employment and by other 14% by those in unemployment respectively of both sexes. Whereas, similar variations in female wage and salary employment are enlarged by 36% of those in its male counterpart, while they are reduced by 72% by those in family employment and by other 15% by those in unemployment respectively of both sexes. Thus, 54% of variations in Japanese wage and salary employment in original unit around their Hodrick-Prescott trends are absorbed by similar variations in family employment, while other 11% by those in unemployment which amount to nearly one-fifth of the former. Therefore we can sum up these two types of accounting of variations and covariations based on the Hodrick-Prescott and the cubic trends by inferring with some confidence that variations in Japanese wage and salary employment are absorbed by far more by similar variations in family employment than by those in unemployment.

V. Conclusion

The household sector is incontrovertibly large. Household or family employment comprising self-employed and unpaid family workers and persons not in labor force but engaged in household production constitute 53% in Japan and 45% of WAP in US, while business employment or private wage and salary workers its 45% or 15% less in Japan and its 46% or 34% more than the former in US. On the other hand, household expenditures for consumer services and nondurables constitute 59% in US and 48% of GDP in Japan. Furthermore, household investment, i.e., the sum of consumer durables and residential investment (20% in Japan and 12% of GDP in US) exceeds business investment in equipment and structures in the two countries (14 and 10% respectively of GDP), which combines with its share in WAP to imply that the household sector is more capital intensive than the business sector in the two countries. (See also Greenwood and Hercowitz, 1991 in this regard.)

Detrending by means of the Hodrick-Prescott filter and others reveals that all classes of family employment other than female self-employed in US while female self-employed and women not in labor force in Japan are negatively correlated with male wage and salary employment. On the other hand, all classes of family employment other than female self-employed in Japan while male and female self-employed in US are negatively correlated with female wage and salary employment. In consequence, family employment absorbs 54% of variations in wage and salary employment, while unemployment 11% or one-fifth of those absorbed by the former in Japan. On the other hand, unemployment absorbs 57% of variations in wage and salary employment, while family employment 40% of those absorbed by the former in US. Differences in the rates of absorption may partly due to the difference in thickness of the classes of family employment in the two countries. Thus, variations in family employment help the wage and salary workers to meet variations in the employment demand for them that are positively correlated with GDP. Hence they should moderate variations in the rates of wage and salary over aggregate fluctuations. However, the resulting countercyclical fluctuations in family employment aggravate the fluctuations in the marginal revenue product of family workers to render the wage differential between the business and household sectors coutercyclical, as clearly observed in case their output is marketable, e.g., in agriculture, service trades and others where family workers are numerous. See, Taira (1970), Okun (1982) and others.

Household expenditures for consumer services and nondurables as well as government consumption expenditures prove to be less volatile than GDP in the two countries. Similarly the sum of consumer durables and residential investment is estimated to be less volatile than the sum of business investment in equipment and structures, and change in inventories in the two countries. Furthermore, government structures and imports in Japan while national defense and imports in US are negatively correlated with GDP. Three sectors of government investment, residential investment, consumption expenditures of government and nonprofit institutions, and imports are negatively correlated with business investment in equipment in Japan. Thus, the household sector with its large GDP share cooperate with the government and imports to moderate fluctuations in the demand for business output that are positively correlated with GDP and thereby stabilize its price over aggregate fluctuations. On the other hand, relatively stable household consumption expenditures and investments combine with countercyclical household employment to render household output extremely stable, while they render the relative price of this sector extremely volatile and procyclical, as clearly observed in case the kind of output is marketable, e.g., in agriculture, service and other industries where family workers are numerous. See Schultz (1945), Hart and Kenen (1948) and others. An extremely procyclical relative price of this sector, in turn, should induce households to substitute purchased for home produced goods and service during aggregate expansion while to substitute the other way round during aggregate recession as indicated by Grossman (1973), Ghez and Becker (1975) in a slightly different context.

Thus, the long-lived notion that the household or self-employed sectors of the economy tend to stabilize aggregate fluctuations both in terms of employment and demand for goods and services has been verified. Hence, it is inferred that these households can be thought of as carrying out the countercyclical policies of Keynes' type in their private capacity, though they may not be conscious of them.

Appendix 1.

1) In case firms are competitive with no residual profits imputed and their technology is of the Cobb-Douglas type, the Jacobian A associated with the inequalities (1)～(10) above is expanded and reduced into the following expression, which proves to be negative if leisure and output of households are normal goods.

$$A = m^3 n(2prwG_{21} + r^2 wM|G| \{p(pU_{11} - w^* U_{21}) - w^* (pU_{12} - w^* U_{22}) + \lambda p^3 \ F_{11}\}$$

$$+ \lambda m^3 np^3 ww^{*2} F_{22} G_2 G_{21} \ < 0, \ |G| \equiv G_{11} G_{22} - G_{12} G_{21} \ > 0$$

Appendix 2.

$$\frac{dM}{dI} A = nG_1 C + \eta_p(M)M|G|m \frac{\partial Q_s}{\partial r} CF_2 - \eta_r(M)M|G|m \frac{\partial Q_s}{\partial p} C; A \ < 0, \ C \ < 0$$

$$(1) \ \ nG_1 C = m^2 p \{- pF_{22}(pU_{11} - w^* U_{21}) + w^* F_{22}(pU_{12} - w^* U_{22}) - \lambda p^3 |F| \} nG_1 < 0,$$

$$|F| \equiv F_{11} F_{22} - F_{12} F_{21} > 0$$

$$(2) \ \ \eta_p(M)M|G|m \frac{\partial Q_s}{\partial r} CF_2$$

$$= m^3 F_2{}^2 \{- p(pU_{11} - w^* U_{21}) + w^* (pU_{12} - w^* U_{22}) - \lambda p^3 F_{11}\} rG_2 G_{12} \ (> 0)$$

$$- m^3 rK \{F_{22}(pU_{11} - w^* U_{21}) + (F_2 F_{12} - F_1 F_{22})(pU_{12} - w^* U_{22})$$

$$+ \lambda p^2 \ |F| \} rG_2 G_{12} \ \ (< 0) \gtrless \ 0$$

$$(3) \ \ \eta_r(M)M|G|m \frac{\partial Q_s}{\partial p} C$$

$$= m^3 F_2{}^2 \{p(pU_{11} - w^* U_{21}) - w^* (pU_{12} - w^* U_{22}) + \lambda p^3 F_{11} \} r(G_2 G_{12} - G_1 G_{22}) \ (< 0)$$

$$+ m^3 pQ_s \{F_{22}(pU_{11} - w^* U_{21}) + (F_2 F_{12} - F_1 F_{22})(pU_{12} - w^* U_{22})$$

$$+\lambda p^2|F|\}r(G_2G_{12}-G_1G_{22})\ (>0) \gtrless 0$$

The first group of terms on the right hand side proves to be negative owing both to the normality of leisure and output of households and to the concavity of the production function of households. Then the first three positive terms of the second group involving the substitution effect $\eta_p(M)$ respectively are more than offset by the corresponding negative terms of the third group involving the output effect $\eta_r(M)$ in firms, which should be clear from their forms. The following three negative terms respectively are offset by the corresponding positive terms in case firms are competitive and their the technology is of the Cobb-Douglas type: $G(.) = aM^{\alpha}N^{\beta}, \alpha+\beta < 1$. For instance, put

$$D \equiv -\lambda m^3p^3F_2K|F|rG_2G_{12}+\lambda m^3p^3Q_s|F|r(G_2G_{12}-G_1G_{22})$$

Then,

$$D=\lambda m^3p^2r|F|\{-rKG_2G_{12}/M|G|+pQ_s(G_2G_{12}-G_1G_{22})/M|G|\}M|G|,$$

since $pF_2 = r$ from the relation (6) above in equality. Furthermore,

$$D=\lambda m^2np^2r|F|\{-(wM+pN)\eta_p(M)+pN\eta_r(M)\}M|G|,$$

since $mQ_s = nN$, $mL_s = nM$ and $pQ_s + wL_s = rK$ from the relations (1),(3) and (4) in equality.

In case $\pi_2 = ra\,M^{\alpha}N^{\beta} - wM - pN = 0$ as assumed,

$$D=\lambda m^2np^2r|F|\{-(wM+pN)\beta+pN\}M|G|/(1-\alpha-\beta)=0$$

Therefore, we have $dM/dI > 0$ since $A < 0$ and six negative terms of the first and third groups remain.

Appendix 3.

$$\frac{dL}{dI}A=nG_1\frac{\partial L}{\partial M}C-n\eta_p(N)N|G|\frac{\partial L}{\partial r}CF_2-n\eta_r(N)N|G|\frac{\partial L}{\partial p}C$$

$$-\eta_p(M)M|G|\frac{m\partial^2}{\partial r\partial M}(L,Q_s^*)CF_2-\eta_r(M)M|G|\frac{m\partial^2}{\partial p\partial M}(L,Q_s^*)CF_2$$

$$-r^2|G|\frac{m\partial^2}{\partial p\partial r}(L,Q_s^*)C;\ A<0,\ C<0$$

(1) $$nG_1\frac{\partial L}{\partial M}C = mn^2pF_{22}\left\{p(U_{11}-w^*U_{21})-w(pU_{12}-w^*U_{22})\right\}G_1 > 0$$

(2) $$-n r\eta_p(N)N|G|\frac{\partial L}{\partial r}CF_2 = -m^2nr^2\left\{KF_{22}(pU_{12}-w^*U_{22})+\lambda p^2F_{12}\right\}G_2\,G_{11} \gtrless 0$$

(3) $$-n r\eta_r(N)N|G|\frac{\partial L}{\partial p}C = m^2npr\left\{Q_sF_{22}(pU_{12}-w^*U_{22})+\lambda prF_{12}\right\}(G_2\,G_{11}-G_1G_{21}) \gtrless 0$$

(4) $$-r\eta_p(M)M|G|\frac{m\partial^2}{\partial r\partial M}(L,Q_s^*)CF_2$$

$$= m^2nr^2\left\{KF_{22}(pU_{11}-w^*U_{21})+\lambda pwF_{12}\right\}G_2\,G_{12}(>0)$$

$$+m^2nrF_2{}^2\left\{p(pU_{11}-w^*U_{21})-w(pU_{12}-w^*U_{22})\right\}G_2\,G_{12}(<0) \gtrless 0$$

(5) $$-r\eta_r(M)M|G|\frac{m\partial^2}{\partial p\partial M}(L,Q_s^*)CF_2$$

$$= -m^2npr\left\{Q_sF_{22}(pU_{11}-w^*U_{21})+\lambda rwF_{12}\right\}(G_2\,G_{12}-G_1\,G_{22})(<0)$$

$$+m^2nrF_2{}^2\left\{-p(pU_{11}-w^*U_{21})+w(pU_{12}-w^*U_{22})\right\}(G_2\,G_{12}-G_1\,G_{22})(>0) \gtrless 0$$

(6) $$-r^2|G|\frac{m\partial^2}{\partial p\partial r}(L,Q_s^*)C = m^3(-KF_2+Q_s)\left\{F_2(pU_{12}-w^*U_{22})-\lambda p^2F_{12}\right\}r^2|G| \gtrless 0$$

The first group of terms on the right hand side proves to be positive owing both to the normality of leisure and output of households and to the concavity of the production function of households. The negative term of the third group involving the output effect $\eta_r(N)$ offsets the corresponding two positive terms of the second and fourth groups involving the substitution effects $\eta_p(M)$ and $\eta_p(N)$ in firms. Then the two negative terms of the fourth group involving the substitution effect $\eta_p(M)$ are more than offset by the corresponding positive terms of the fifth group involving the output effect $\eta_r(M)$ in firms. Furthermore the two terms involving K in the second and fourth groups are offset respectively by the corresponding terms involving Q_s in the third and fifth groups in the similar way as shown in the preceding appendix in case firms are competitive and their technology is of the Cobb-Douglas type.

The remaining negative terms of the fifth and sixth groups are sufficiently offset by the positive terms of the first as well as of the fifth and sixth groups in case both firms and households are competitive, and their technologies and the household welfare are of the Cobb-Douglas type as will be shown below. Put

$$D \equiv -mn^2wF_{22}(pU_{12}-w^*U_{22})rG_1G_2 - m^2nwF_2{}^2(pU_{12}-w^*U_{22})rG_1G_{22}$$

$$-\lambda m^2np^2wF_2F_{12}r(G_2G_{12}-G_1G_{22})+m^3(-KF_2+Q_s)\{F_2(p^2U_{12}-w^*U_{22})-\lambda p^2F_{12}\}r^2|G|$$

Since $mpKF_2 - mpQ_s = nwM$ from the relations (3), (4) and (6) above in equality,

$$D = -mn^2wF_{22}(pU_{12}-w^*U_{22})rG_1G_2 - m^2nwF_2{}^2(pU_{12}-w^*U_{22})rG_1G_{22}$$

$$-\lambda m^2np^2wF_2F_{12}r(G_2G_{12}-G_1G_{22}) - m^2nwMF_2{}^2(pU_{12}-w^*U_{22})r|G| + \lambda m^2npwF_{12}r^2|G|$$

Then,

$$D = \lambda mnprw\left\{-np\frac{F_1F_{22}}{L|F|}\frac{1}{q}\varepsilon_q(R)\frac{G_1G_2}{M|G|} - mr\frac{F_1F_2}{L|F|}\frac{1}{q}\varepsilon_q(R)\frac{G_1G_{22}}{M|G|}\right.$$

$$\left.-mp\frac{F_2F_{12}}{L|F|}\frac{G_2G_{12}-G_1G_{22}}{M|G|} - mr\frac{F_1F_2}{L|F|}\frac{1}{q}E_q(R) + mp\frac{F_2F_{12}}{L|F|}\right\}L|F|M|G|,$$

since $pU_{12}-w^*U_{22} = pU_1\varepsilon_q(R)/q$, $\varepsilon_q(R) \equiv \partial \ln R/\partial \ln q$, $R \equiv U_1/U_2$, and $U_1 = \lambda pF_1$ from the relations (5) and (7) above in equality. For the household welfare and the technologies of Cobb-Douglas type,e.g., $F(L,K) = a^*L^{\alpha^*}K^{\beta^*}, \alpha^* + \beta^* < 1$, and $G(M,N) = aM^{\alpha}N^{\beta}, \alpha + \beta < 1$, the expression D^* in the bracket { } above is evaluated as follows:

$$D^* = \{ -npN(\beta^* - 1) - mrK(\beta - 1) - mpq\beta^* - mrK(1 - \alpha - \beta)$$

$$+ mpq\beta^*(1 - \alpha - \beta)\} / (1 - \alpha^* - \beta^*)q(1 - \alpha - \beta).$$

In case both firms and households are competitive with no residual profits imputed, we find after some calculation by an appropriate use of the relations (3),(4) and (6) that $D^* = mp\beta^* / (1 - \alpha^* - \beta^*) > 0$. Therfore we have $dL / dI < 0$, since $A < 0$ and two positive terms of the first and fifth groups remain.

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Table 1.1. Secular Trends and Quarterly Fluctuations by GDP Sectors: Japan 1971.1~1993.3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

GDP Sectors	Means for the Period bil. 1990 yen		Autocorrel. 1st Order	Aver. Growth Rates(%)	Variances in Orig. Unit[a] ar. H-P Trend		Std. Deviations (%)	
Household Expenditures								
(1) consumer durables	31.09	(.0421)	.527	2.278	2.974	(.0222)	6.610	(4.077)
(2) consumer semidurables	52.68	(.0713)	.429	.725	3.049	(.0228)	3.369	(2.078)
(3) consumer nondurables	133.95	(.1814)	.086	.607	3.106	(.0232)	1.330	(.820)
(4) consumer services	214.58	(.2906)	.540	1.062	9.862	(.0738)	1.519	(.937)
(5) others	3.13	(.0042)	.684	2.438	.179	(.0013)	16.091	(9.925)
(6) Nonprofit Inst. Expend.	4.77	(.0065)	-.199	.658	.767	(.0076)	24.982	(15.410)
(7) Gov. Consumption Expend.	69.35	(.0939)	.053	.834	.756	(.0057)	1.279	(.789)
Gross Dom. Cap. Formation								
(8) Business Equipment	101.00	(.1368)	.852	1.241	27.121	(.2028)	5.640	(3.479)
(9) Business Structures	3.86	(.0052)	.879	.104	.425	(.0032)	17.116	(10.558)
(10) Change in Inventories	7.34	(.0099)	-.024	1.155	22.658	(.1695)	47.351	(29.208)
(11) Government General	38.25	(.0518)	.263	1.114	8.069	(.0603)	7.463	(4.603)
(12) Gov. Enterprises equip.	16.96	(.0230)	.544	.103	1.424	(.0106)	7.159	(4.416)
(13) Gov. Structures	2.44	(.0033)	.465	.065	.045	(.0003)	8.931	(5.509)
(14) Household Equipment[b]	23.20	(.0314)	.511	.560	1.236	(.0092)	4.907	(3.027)
(15) Household Structures[c]	39.16	(.0530)	.595	.474	6.370	(.0476)	6.507	(4.015)
(16) Exports	92.38	(.1251)	.594	1.677	16.966	(.1269)	4.883	(3.012)
(17) Imports	95.67	(.1296)	.811	1.129	33.122	(.2477)	6.193	(3.820)
(18) Gross Domestic Product	738.46	(1.0000)	.606	1.007	133.706	(1.0000)	1.621	(1.000)

a) Trillion 1990 yen
b) Gross investment in equipment by individual proprietors.
c) Gross residential investment and gross investment in structures by individual proprietors.

Table 1.1.a. Secular Trends and Quarterly Fluctuations by GDP Sectors : U.S.A. 1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda=1600$)

GDP Sectors	Means for the Period bil. chained 1992 dol.		Autocorrel. 1st Order	Aver. Growth Rates(%)		Variances in Orig. Unit[a] ar. H-P Trend		Std. Deviations (%)	
Household expenditures									
(1) consumer durables	425.42	(.0767)	.751	.961	(1.516)	337.22	(.0457)	4.522	(2.870)
(2) consumer nondurables	1,217.71	(.2196)	.840	.452	(.712)	139.42	(.0189)	.976	(.619)
(3) consumer services	2,076.49	(.3745)	.831	.736	(1.161)	256.03	(.0347)	.785	(.498)
(4) Gov. consumption expend.	642.92	(.1159)	.663	.493	(.778)	42.73	(.0058)	1.031	(.654)
Gross dom. cap. formation									
(5) Business equipment	358.84	(.0647)	.857	1.289	(2.032)	282.25	(.0383)	4.933	(3.181)
(6) Business structures	188.59	(.0340)	.836	.366	(.577)	88.45	(.0120)	5.032	(3.194)
(7) Residential investment	227.91	(.0411)	.860	.239	(.377)	477.56	(.0648)	10.242	(6.501)
(8) Change in bus. inventories	23.48	(.0042)	.316	.015	(.024)	849.73	(.1152)	69.421	(44.063)
(9) Government equipment	24.23	(.0044)	.724	1.606	(2.533)	.80	(.0001)	4.079	(2.589)
(10) Government structures	98.68	(.0178)	.709	.498	(.785)	24.67	(.0033)	5.061	(3.212)
(11) Exports	473.04	(.0853)	.846	1.608	(2.536)	299.28	(.0406)	3.955	(2.510)
(12) Imports	550.17	(.0992)	.823	1.496	(2.359)	522.19	(.0708)	4.533	(2.877)
(13) National defense	340.75	(.0615)	.520	.196	(.310)	36.57	(.0050)	1.790	(1.136)
(14) Residuals	-2.34	(-.0004)	.687	1.151	(1.816)	81.41	(.0110)	54.675	(34.704)
(15) Gross domestic product	5,544.99	(1.0000)	.848	.634	(1.000)	7,375.19	(1.0000)	1.576	(1.000)

a) Trillion chained 1992 dollars.

Table 1.2. Comovements between GDP Sectors: Japan 1971.1～1993.3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda=1600$)

GDP Sectors	Correlations with		Cov. in Orig. Unit[a] ar. H-P Trend with				Cov.[a] ar. Cubic Trend[b] with			
	Bus.Equip.	GDP	Bus.Equipment		GDP		Bus. Equipment		GDP	
Household Expenditures										
(1) consumer durables	.3599	.6579	3.336	(.123)	130.201	(.099)	30.079	(.272)	49.861	(.180)
(2) consumer semidurables	.3951	.7118	3.687	(.136)	14.520	(.109)	11.512	(.104)	22.685	(.082)
(3) consumer nondurables	.1861	.5753	1.802	(.066)	11.801	(.088)	2.861	(.026)	10.290	(.037)
(4) consumer services	.4910	.5590	8.084	(.298)	20.437	(.153)	25.475	(.230)	41.294	(.149)
(5) others	.5313	.4764	1.192	(.044)	2.345	(.018)	6.673	(.060)	10.080	(.036)
(6) Nonprofit Inst. Expend.	-.0008	.0884	-.239	(-.009)	.641	(.005)	-3.163	(-.029)	-3.177	(-.011)
(7) Gov. Consumption Expend.	-.0900	.1355	-.400	(-.015)	1.346	(010)	-2.245	(-.020)	-.722	(-.003)
Gross Dom. Cap. Formation										
(8) Business Equipment	1.0000	.6308	27.121	(1.000)	38.104	(.285)	110.613	(1.000)	151.284	(.547)
(9) Business Structures	.6522	.7498	2.283	(.084)	5.606	(.042)	11.775	(.106)	17.965	(.065)
(10) Change in Inventories	.2508	.4593	6.813	(.251)	22.818	(.171)	20.101	(.182)	45.076	(.163)
(11) Government General	-.1955	.0945	-2.806	(-.103)	3.622	(.027)	-12.908	(-.117)	-10.945	(-.040)
(12) Gov. Enterprises equip.	-.2089	.1078	-1.256	(-.046)	1.571	(.012)	-7.148	(-.065)	-4.853	(-.018)
(13) Gov. Structures	-.4820	-.3953	-.532	(-.020)	-.946	(-.007)	-1.140	(-.010)	-1.785	(-.006)
(14) Household Equipment[c]	.3782	.4666	2.194	(.081)	6.033	(.045)	10.804	(.098)	18.171	(.066)
(15) Household Structures[d]	-.0343	.3485	-.222	(-.008)	10.163	(.076)	14.806	(.134)	29.316	(.106)
(16) Exports	.1549	.0589	3.192	(.118)	2.769	(.021)	4.667	(.042)	8.902	(.032)
(17) Imports	-.6541	-.5069	-19.751	(-.728)	-33.699	(-.252)	-71.478	(-.646)	-107.024	(-.387)
(18) Gross Domestic Product	.6308	1.0000	38.104	(1.405)	133.706	(1.000)	151.284	(1.368)	276.417	(1.000)

a) Trillion 1990 yen.
b) Cubic trends are estimated on the basis of quasi-first differences by use of the iterative SUR method with all autoregression coefficients set to be identical for the period (1971.2～1993.3).
c) Gross investment in equipment by individual proprietors.
d) Gross residential investment and gross investment in structures by individual proprietors.

Table 1.2.a. Comovements between GDP Sectors : U.S.A.1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

WAP Classes	Correlations with		Cov. in Orig. Unit[a] ar. H-P Trend with				Cov.[a] ar. Cubic Trend[b] with			
	Bus. Equip.	GDP	Bus. Equipment		GDP		Bus. Equipment		GDP	
Household expenditures										
(1) consumer durables	.7597	.7795	234.96	(.8325)	1,227.99	(.1665)	567.35	(1.186)	2,736.55	(.179)
(2) consumer nondurables	.7924	.8190	157.88	(.5594)	831.98	(.1128)	316.09	(.661)	2,018.42	(.132)
(3) consumer services	.7290	.7996	195.96	(.6943)	1,098.06	(.1489)	463.96	(.970)	3,034.92	(.198)
(4) Gov. consumption expend.	.2233	.3037	24.88	(.0881)	172.20	(.0233)	-30.38	(-.064)	782.90	(.051)
Gross dom. cap. formation										
(5) Business equipment	1.0000	.9190	282.25	(1.0000)	1,323.25	(.1794)	478.30	(1.000)	2,196.26	(.144)
(6) Business structures	.5096	.4401	79.56	(.2819)	350.77	(.0476)	130.54	(.273)	288.40	(.019)
(7) Residential investment	.6698	.7403	248.27	(.8796)	1,389.72	(.1884)	453.16	(.947)	3,145.87	(.206)
(8) Change in bus. inventories	.4754	.5320	228.58	(.8098)	1,322.34	(.1793)	307.29	(.642)	1,315.31	(.086)
(9) Government equipment	.3432	.3986	5.24	(.0186)	30.41	(.0041)	17.42	(.036)	73.27	(.005)
(10) Government structures	.4698	.5710	38.77	(.1374)	241.82	(.0328)	26.71	(.056)	483.81	(.032)
(11) Exports	.2860	.3791	80.23	(.2843)	556.77	(.0755)	-7.51	(-.157)	1,131.36	(.074)
(12) Imports	-.8313	-.8071	-318.28	(-1.1277)	-1,575.67	(-.2136)	-758.70	(-1.586)	-2,955.94	(-.193)
(13) National defense	-.3000	-.2639	-30.74	(-.1089)	-137.65	(-.0187)	202.72	(.424)	213.87	(.014)
(14) Residuals	.7026	.7041	99.43	(.3523)	533.96	(.0724)	29.30	(.061)	791.67	(.052)
(15) Gross domestic product	.9190	1.0000	1,323.25	(4.6882)	7,375.19	(1.0000)	2,196.26	(4.592)	15,296.66	(1.000)

a) Trillion chained 1992 dollars.
b) Cubic trends are estimated on the basis of quasi-first differences by use of the iterative SUR method with all autoreggrssion coefficients set to be identical for the period (1976.4~1997.2).

Table 1.3. Secular Trends and Quarterly Fluctuations by Classes of Working Age Population: Japan1971.1～1993.3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda=1600$)

WAP Classes	Means for the Period million persons		Autocorrel. 1st Order	Aver. Growth Rates(%)		Variances in Orig. Unit[a)] ar. H-P Trend		Std. Deviations (%)	
Male									
(1) Self-Employed Wkrs	6.380	(.0699)	.337	-.195	(-.648)	60.770	(.207)	1.2237	(.755)
(2) Unpaid Family Wkrs	1.188	(.0130)	.351	-.750	(-2.492)	17.016	(.058)	3.4715	(2.141)
(3) Not in Labor Force	9.046	(.0991)	.417	.553	(1.837)	100.110	(.341)	1.1259	(.695)
(4) Unemployed Wkrs	.767	(.0084)	.598	.841	(2.794)	44.299	(.151)	9.0535	(5.584)
(5) Wage & Sal Wkrs[b)]	27.001	(.2957)	.666	.376	(1.249)	303.056	(1.032)	.6486	(.400)
Female									
(6) Self-Employed Wkrs	2.842	(.0311)	.588	-.136	(-.452)	66.762	(.227)	2.8438	(1.754)
(7) Unpaid Family Wkrs	4.754	(.0521)	.293	-.537	(-1.784)	126.213	(.430)	2.3684	(1.461)
(8) Not in Labor Force	24.160	(.2646)	.583	.253	(.841)	440.507	(1.499)	.8713	(.537)
(9) Unemployed Wkrs	.486	(.0053)	.528	1.181	(3.924)	9.639	(.033)	6.9119	(4.263)
(10) Wage & Sal Wkrs[b)]	14.702	(.1610)	.507	.680	(2.259)	332.084	(1.130)	1.2619	(.778)
(11) Wkg Age Popul[c)]	91.326	(1.0000)	.280	.301	(1.000)	293.791	(1.000)	.1886	(.116)
(12) Bus. Equipment	—	—	.852	1.241	(4.123)	—	—	5.6397	(3.479)
(13) GDP	—	—	.606	1.007	(3.346)	—	—	1.6212	(1.000)

a) Billion persons.
b) Government wage and salary workers constitute 2.12% of WAP.
c) 15 years and older.

Table 1.3.a. Secular Trends and Quarterly Fluctuations by Classes of Working Age Population: U.S.A.1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

WAP Classes	Means for the Period million persons		Autocorrel. 1st Order	Aver. Growth Rates(%)		Variances in Orig. Unit[a] ar. H-P Trend		Std. Deviations (%)	
Male									
(1) Self-Employed Wkrs	6.520	(.0360)	.502	.148	(.481)	79.242	(.107)	1.8339	(1.164)
(2) Unpaid Family Wkrs	.104	(.0006)	.456	-1.215	(-3.945)	1.783	(.002)	13.3004	(8.442)
(3) Not in Labor Force	20.494	(.1130)	.432	.487	(1.581)	386.348	(.521)	.9720	(.617)
(4) Unemployed Wkrs	3.792	(.0209)	.883	.114	(.370)	2,222.978	(2.997)	12.1477	(7.710)
(5) Wage & Sal Wkrs[b]	54.829	(.3024)	.879	.309	(1.003)	4,652.275	(6.272)	1.2468	(.791)
Female									
(6) Self-Employed Wkrs	2.932	(.0162)	.667	1.020	(3.312)	87.408	(.118)	3.3236	(2.110)
(7) Unpaid Family Wkrs	.371	(.0020)	.680	-2.356	(-7.649)	17.122	(.023)	12.5969	(7.995)
(8) Not in Labor Force	42.570	(.2348)	.620	-.020	(-.065)	590.903	(.797)	.5679	(.360)
(9) Unemployed Wkrs	3.019	(.0166)	.870	.100	(.325)	533.202	(.719)	7.4439	(4.725)
(10) Wage & Sal Wkrs[b]	45.589	(.2514)	.827	.588	(1.909)	2,128.187	(2.869)	1.0198	(.647)
(11) Wkg Age Popul[c]	181.337	(1.0000)	.782	.308	(1.000)	741.802	(1.000)	.1158	(.074)
(12) Bus. Equipment	—	—	.857	1.289	(4.185)	—	—	4.9326	(3.181)
(13) GDP	—	—	.848	.634	(2.058)	—	—	1.5755	(1.000)

a) Billion persons.

b) Government wage and salary workers constitute 9.22% of WAP.

c) 16 years and older.

Table 1.4. Comovements between WAP Classes and Selected GDP Sectors: Japan 1971.1~1993.3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier λ=1600)

WAP Classes	Correlations with				Cov. in Orig. Unit[a] ar. H-P Trend with				Cov.[a] ar. Cubic Trend[b] with			
	M.W&S Wkrs	F.W&S Wkrs	Bus. Equip.	GDP	Male W&S Wkrs		Female W&S Wkrs		Male W&S Wkrs		Female W&S Wkrs	
Male												
(1) Self-Employed Wkrs	-.5697	-.0921	.0809	.2011	-77.385	(-.255)	-13.018	(-.039)	-142.973	(-.311)	-34.621	(-.077)
(2) Unpaid Family Wkrs	-.4579	-.0006	.1028	.1700	-33.015	(-.109)	-.270	(-.001)	-53.196	(-.116)	-5.448	(-.012)
(3) Not in Labor Force	-.5173	-.0776	-.1482	-.1402	-90.312	(-.298)	-14.381	(-.043)	-198.156	(-.431)	-153.701	(-.342)
(4) Unemployed Wkrs	-.2569	-.3083	-.7579	-.5621	-27.588	(-.091)	-36.868	(-.111)	-46.369	(-.101)	-55.259	(-.123)
(5) Wage & Sal Wkrs	1.0000	.3716	.4330	.1922	303.056	(1.000)	118.581	(.357)	459.805	(1.000)	227.144	(.505)
Female												
(6) Self-Employed Wkrs	.2411	.3347	.3574	.4204	35.390	(.117)	50.475	(.152)	67.651	(.147)	63.525	(.141)
(7) Unpaid Family Wkrs	-.5523	-.1414	.0758	.2790	-108.580	(-.358)	-29.217	(-.088)	-172.320	(-.375)	-28.027	(-.062)
(8) Not in Labor Force	.1174	-.6071	-.2726	-.4680	42.613	(.141)	-232.197	(-.699)	-76.393	(-.166)	-457.633	(-1.018)
(9) Unemployed Wkrs	-.2863	-.2540	-.6592	-.4811	-15.088	(-.050)	-14.301	(-.043)	-13.558	(-.029)	-18.146	(-.040)
(10) Wage & Sal Wkrs	.3716	1.0000	.4211	.4423	120.351	(.397)	332.084	(1.000)	227.144	(.494)	449.605	(1.000)
(11) Wkg Age Popul[c]	.4034	.4469	.2396	.1106	38.857	(.128)	139.974	(.422)	51.455	(.112)	-12.388	(-.028)
(12) Bus. Equipment	.433	.4211	1.0000	.6308	—	—	—	—	—	—	—	—
(13) GDP	.1922	.4423	.6308	1.0000	—	—	—	—	—	—	—	—

a) Billion persons
b) Cubic trends are estimated on the basis of quasi-first differences by use of the iterative SUR method with all autoregression coefficients set to be identical for the period (1971.2~1993.3).
c) 15 years and older.

Table 1.4.a. Comovements between WAP Classes and Selected GDP Sectors : U.S.A.1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier λ=1600)

WAP Classes	Correlations with				Cov. in Orig. Unit[a] ar. H-P Trend with				Cov.[a] ar. Cubic Trend[b] with			
	M.W&S Wkrs	F.W&S Wkrs	Bus.Equip	GDP	Male W&S Wkrs		Female W&S Wkrs		Male W&S Wkrs		Female W&S Wkrs	
Male												
(1) Self-Employed Wkrs	-.0127	.0408	.0099	.0558	-9.046	(-.002)	16.148	(.008)	-10.708	(-.011)	-4.044	(-.009)
(2) Unpaid Family Wkrs	-.2623	-.2620	-.2376	-.2619	-24.365	(-.005)	-16.634	(-.008)	-5.868	(-.006)	-3.490	(-.008)
(3) Not in Labor Force	-.5904	-.4527	-.4426	-.4892	-793.540	(-.171)	-410.487	(-.193)	-171.304	(-.178)	-105.026	(-.235)
(4) Unemployed Wkrs	-.9223	-.8138	-.9086	-.9218	-2,974.166	(-.639)	-1,761.658	(-.828)	-679.021	(-.706)	-424.574	(-.949)
(5) Wage & Sal Wkrs	1.0000	.8780	.8852	.9144	4,652.275	(1.000)	2,761.413	(1.298)	961.859	(1.000)	610.668	(1.365)
Female												
(6) Self-Employed Wkrs	.2953	.2517	.2157	.2256	187.889	(.040)	108.507	(.051)	33.867	(.035)	19.713	(.044)
(7) Unpaid Family Wkrs	-.1101	-.1209	-.0381	-.0488	-32.825	(-.007)	-23.719	(-.011)	.783	(.001)	-.077	(-.000)
(8) Not in Labor Force	-.5619	-.7764	-.4930	-.5585	-935.089	(-.201)	-871.958	(-.410)	-262.568	(-.273)	-207.306	(-.463)
(9) Unemployed Wkrs	-.9006	-.8206	-.8177	-.8422	-1,419.169	(-.305)	-868.191	(-.408)	-344.382	(-.358)	-223.381	(-.499)
(10) Wage & Sal Wkrs	.8780	1.0000	.7671	.8145	2,761.413	(.594)	2,128.187	(1.000)	610.668	(.635)	447.325	(1.000)
(11) Wkg Age Popul[c]	.5006	.5980	.2562	.3124	930.928	(.200)	751.504	(.353)	133.326	(.139)	109.807	(.245)
(12) Bus. Equipment	.8852	.7671	1.0000	.9190	—	—	—	—	—	—	—	—
(13) GDP	.9144	.8145	.9190	1.0000	—	—	—	—	—	—	—	—

a) Billion persons.
b) Cubic trends are estimated on the basis of quasi-first differences by use of the iterative SUR method with all autoreggrssion coefficients set to be identical for the period (1976.4~1997.2).
c) 16 years and older.

Table 2.1. Correlation Matrix between GDP Sectors: Japan 1971.1~1993.3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier λ=1600)

GDP Sectors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Household Expenditures									
(1) consumer durables	1.0000								
(2) consumer semidurables	.6096	1.0000							
(3) consumer nondurables	.5369	.6180	1.0000						
(4) consumer services	.4486	.4848	.3708	1.0000					
(5) others	.5928	.3234	.2341	.6230	1.0000				
(6) Nonprofit Inst. Expend.	.0139	-.0170	-.0004	-.0233	-.0971	1.0000			
(7) Gov. Consumption Expend.	.1135	.1047	.1390	-.0312	-.1675	.0484	1.0000		
Gross Dom. Cap. Formation									
(8) Business Equipment	.3599	.3951	.1861	.4910	.5313	-.0008	-.0900	1.0000	
(9) Business Structures	.6374	.5188	.2948	.5231	.6144	-.0277	-.0704	.6522	1.0000
(10) Change in Inventories	.2380	.3103	.2182	.0616	.1604	.1978	.0143	.2508	.2958
(11) Government General	.1995	.0106	-.0310	.1913	.2137	.1247	-.1327	-.1955	.1423
(12) Gov. Enterprises equip.	.1223	.0919	.0451	.1397	.1024	-.0563	.1420	-.2089	.0714
(13) Gov. Structures	-.3189	-.3132	-.2037	-.1248	-.2701	.0879	-.0254	-.4820	-.4912
(14) Household Equipment[a]	.4287	.2682	.2080	.2647	.4158	.0603	.1248	.3782	.5113
(15) Household Structures[b]	.4153	.2458	.1941	.3097	.4346	-.1032	.0440	-.0343	.5393
(16) Exports	-.2932	-.0398	-.0649	-.3444	-.3031	.0853	.0381	.1549	-.1611
(17) Imports	-.5159	-.4181	-.2514	-.5244	-.7294	-.0165	.1387	-.6541	-.6499
(18) Gross Domestic Product	.6579	.7118	.5753	.5590	.4764	.0884	.1355	.6308	.7498

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(10) Change in Inventories	1.0000								
(11) Government General	-.1803	1.0000							
(12) Gov. Enterprises equip.	-.1540	.5353	1.0000						
(13) Gov. Structures	-.1485	.1948	.0332	1.0000					
(14) Household Equipment[a]	.0883	-.0769	-.0631	-.3556	1.0000				
(15) Household Structures[b]	.0598	.3347	.2332	-.3139	.2876	1.0000			
(16) Exports	.1655	-.5280	-.2784	.0930	-.0912	-.3702	1.0000		
(17) Imports	-.4367	-.0256	.0076	.3373	-.3349	-.2554	-.0469	1.0000	
(18) Gross Domestic Product	.4593	.0945	.1078	-.3953	.4666	.3485	.0589	-.5069	1.0000

a) Gross investment in equipment by individual proprietors.
b) Gross residential investment and gross investment in structures by individual proprietors.

Table 2.1.a. Correlation Matrix between GDP Sectors: U.S.A. 1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

GDP Sectors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Household expenditures								
(1) consumer durables	1.0000							
(2) consumer nondurables	.7651	1.0000						
(3) consumer services	.7265	.7705	1.0000					
(4) Gov. consumption expend.	.1400	.3715	.3013	1.0000				
Gross dom. cap. formation								
(5) Business equipment	.7597	.7924	.7290	.2233	1.0000			
(6) Business structures	.0548	.2874	.2126	.1700	.5096	1.0000		
(7) Residential investment	.8704	.6903	.7346	.1311	.6698	-.1584	1.0000	
(8) Change in bus. inventories	.3295	.3012	.2021	-.0951	.4754	.1862	.3978	1.0000
(9) Government equipment	.3325	.3344	.4224	.1677	.3432	.1925	.3292	.0593
(10) Government structures	.3300	.4088	.4923	.4329	.4698	.3322	.3611	.0946
(11) Exports	-.1297	.1998	.2006	.2300	.2860	.5208	-.1463	.0783
(12) Imports	-.7999	-.7346	-.6772	-.1521	-.8313	-.2166	-.7852	-.5854
(13) National defense	-.0758	-.2693	-.1852	-.0606	-.3000	-.1233	-.2023	-.2044
(14) Residuals	.3593	.3652	.3439	.1164	.7026	.5223	.2929	.5604
(15) Gross domestic product	.7795	.8190	.7996	.3037	.9190	.4401	.7403	.5320

	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(9) Government equipment	1.0000						
(10) Government structures	.3306	1.0000					
(11) Exports	.1218	.4432	1.0000				
(12) Imports	-.3578	-.4520	-.0226	1.0000			
(13) National defense	.0128	-.0625	-.2354	.0960	1.0000		
(14) Residuals	.1355	.4978	.5390	-.5190	-.2477	1.0000	
(15) Gross domestic product	.3986	.5710	.3791	-.8071	-.2639	.7041	1.0000

Table 2. 2. Correlation Matrix between WAP Classes and Selected GDP Sectors: Japan 1971:1~1993:3
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

WAP Classes	(1)	(2)	(3)	(4)	(5)	(6)
Male						
(1) Self-Employed Wkrs	1.0000					
(2) Unpaid Family Wkrs	.2970	1.0000				
(3) Not in Labor Force	.0646	.1169	1.0000			
(4) Unemployed Wkrs	-.1300	-.2065	.0676	1.0000		
(5) Wage & Sal Wkrs	-.5697	-.4579	-.5173	-.2569	1.0000	
Female						
(6) Self-Employed Wkrs	.0771	.0761	-.1472	-.4899	.2411	1.0000
(7) Unpaid Family Wkrs	.6702	.6042	.0263	-.2595	-.5523	.1137
(8) Not in Labor Force	-.2815	-.4208	.2068	.4044	.1174	-.4933
(9) Unemployed Wkrs	-.0910	-.0577	.1055	.7501	-.2863	-.3165
(10) Wage & Sal Wkrs	-.0921	-.0006	-.0776	-.3083	.3716	.3347
(11) Wkg Age Popul[a)]	-.0127	-.2214	.2165	-.0027	.4034	.2375
(12) Bus.Equipment	.0809	.1028	-.1482	-.7579	.4330	.3574
(13) GDP	.2011	.1700	-.1402	-.5621	.1922	.4204
	(7)	(8)	(9)	(10)	(11)	(12)
(7) Unpaid Family Work.	1.0000					
(8) Not in Labor Force	-.5290	1.0000				
(9) Unemployed	-.1867	.2043	1.0000			
(10) Employees	-.1414	-.6071	-.2540	1.0000		
(11) Work. Age Popul.[a)]	-.3032	.1723	-.0450	.4469	1.0000	
(12) Bus.Equipment	.0758	-.2726	-.6592	.4211	.2396	.6308
(13) GDP	.2790	-.4680	-.4811	.4423	.1106	1.0000

a) 15 years and older.

Table2.2.a. Correlation Matrix between WAP Classesand Selected GDP Sectors: U.S.A. 1976.3~1997.2
(Hodrick-Prescott Filter with Smoothness Constraint Multiplier $\lambda = 1600$)

WAP Classes	(1)	(2)	(3)	(4)	(5)	(6)
Male						
(1) Self-Employed Wkrs	1.0000					
(2) Unpaid Family Wkrs	.3187	1.0000				
(3) Not in Labor Force	-.0944	.0505	1.0000			
(4) Unemployed Wkrs	-.0479	.3000	.4257	1.0000		
(5) Wage & Sal Wkrs	-.0127	-.2623	-.5904	-.9223	1.0000	
Female						
(6) Self-Employed Wkrs	-.0623	-.2211	.0194	-.3475	.2953	1.0000
(7) Unpaid Family Wkrs	.3646	.4879	-.2606	.1198	-.1101	-.5361
(8) Not in Labor Force	.1354	.3578	.3593	.5463	-.5619	-.3689
(9) Unemployed Wkrs	-.1390	.1578	.4266	.9274	-.9006	-.3984
(10) Wage & Sal Wkrs	.0408	-.2620	-.4527	-.8138	.8780	.2517
(11) Wkg Age Popul.[a]	.1477	.0360	-.1145	-.2841	.5006	.2873
(12) Bus.Equipment	.0099	-.2376	-.4426	-.9086	.8852	.2157
(13) GDP	.0558	-.2619	-.4892	-.9218	.9144	.2256
	(7)	(8)	(9)	(10)	(11)	(12)
(7) Unpaid Family Wkrs	1.0000					
(8) Not in Labor Force	.1532	1.0000				
(9) Unemployed Wkrs	.1203	.4701	1.0000			
(10) Wage & Sal Wkrs	-.1209	-.7764	-.8206	1.0000		
(11) Wkg Age Popul.[a]	-.1526	-.3240	-.4116	.5980	1.0000	
(12) Bus.Equipment	-.0381	-.4930	-.8177	.7671	.2562	1.0000
(13) GDP	-.0488	-.5585	-.8422	.8145	.3124	.9190

a) 16 years and older.