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Business Cycle Fluctuations in Japanese Macroeconomic Time Series: 1980-2000

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Abstract

This paper provides the robust stylized facts for recent Japanese business cycle fluctuations, by examining the cyclical component of macroeconomic time series based on the frequency domain analysis. The results confirm many of the conventional views on business cycles in Japan. Among the most interesting findings are that non-scheduled hours worked helps to predict the aggregate fluctuations. Distinctively, because of the behavior of non-scheduled cash earnings and bonuses, wages in Japan are very sensitive to changes in the level of economic activity. Also significant, the relationship between money and output has changed dramatically after the collapse of bubble economy in 1991.

JEL numbers: E320
Key words: business cycle fluctuations, Japan, band-pass filter

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I. Introduction

The Japanese economy has experienced many unusual economic developments since the late 1980s, including the collapse of the economic bubble with a precipitous drop in stock and land prices, the subsequent disinflation of domestic prices, and the rapid expansion of nation's budget deficit. Much recent literature has focused on this particular period covering the causes of the economic stagnation in the 1990s and the monetary, fiscal and supply-side solutions proposed for the recovery.[2]

While there is a fair amount of previous work which focuses on particular issues from Japan's experience, there is little work which deals with the business cycle fluctuations that the Japanese economy has confronted during the past twenty years.[3] This is regrettable since business cycle fluctuations are one of the central concepts in macroeconomics.

Table 1 summarizes the history of business cycles in Japan since World War II. According to the Economic and Social Research Institute (ESRI), Cabinet Office, the Japanese economy has experienced thirteen business cycles in the past fifty years.[4]

Both the original and the cyclical component of real output, which is obtained by applying the approximate band-pass filter, are plotted together with the peaks and

[2] See, for instance, Motonishi and Yoshikawa (1999) and Hayashi and Prescott (2002).

[3] Saito (1997) discusses the Japanese business cycle after 1991 in terms of its duration and speed. Yoshizoe et al. (2003) is a remarkable study, empirically examining the business cycle fluctuations from a macroeconomic perspective. Gerlach and Yiu (2004) applies the band-pass filter as one of the techniques for estimating output gaps for Asian countries including Japan.

[4] In the following study, we consider the cyclical component of real output as a proxy of business cycle based on Burns and Mitchell (1946).

troughs of each business cycle in Figure 1.[5] Not surprisingly, fluctuations in real output capture the main stream of business cycles over the period, 1980:Q1-2004:Q3, including the recession of 1985-86, with the appreciation of the yen, the bubble economy and its collapse of the late 1980s and the early 1990s, and another recession from 1997-99 caused by a financial crisis.

The purpose of this paper is to empirically characterize the business cycle fluctuations, and establish the stylized facts for the Japanese economy since 1980, based on the observable macroeconomic time series. To this end we apply frequency domain analysis of time series, following Stock and Watson (1999).[6]

The results of this study provide the robust stylized facts which confirm conventional views on Japanese business cycle fluctuations: for instance, non-scheduled hours worked has played a key role as a buffer for labor inputs, and wages in Japan are significantly related to the economic activities through non-scheduled cash earnings and bonuses. Also, in a business cycle sense, the relationship between money and output has dramatically changed after the collapse of bubble economy in 1991. This finding is potentially useful in understanding the mechanism behind the economic stagnation of

[5] The approximate band-pass filter applied in this study is the $BP_{12}(6,32)$, corresponding with the definition of business cycle in Burns and Mitchell (1946), that is the cyclical component of real output in the range of six quarters to thirty-two quarters. See Baxter and King (1999) and Christiano and Fitzgerald (2003) for detailed discussion on the approximate band-pass filter. Harvey and Trimbur (2003) present an alternative procedure for extracting cyclical components of macroeconomic time series relying on model-based filters.

[6] In the appendix, we also examine the longer time series after World War II, applying quarterly data on major aggregate series. Our findings confirm the cyclical regularities of series after World War II are mostly consistent with those for the past two decades.

Japan during the 1990s.

By providing Japan's stylized facts, this study also contributes to the growing comparative literature on the modern. Stock and Watson (1999) have established the stylized facts for the U.S. economy since World War II. In advance of this U.S. work, Englund et al. (1992) have presented the stylized facts for Swedish business cycles over 100 years, applying a combination procedure of the Hodrick-Prescott (1980) filter and the band-pass filter. Backus and Kehoe (1992) are also noteworthy for their explicit comparison of international business cycle properties.

In the next section, we briefly describe the properties of the macroeconomic time series and classic statistics that will be used in this study. In section three, we report our findings, that is the stylized facts for the Japanese business cycle fluctuations based on the empirical characters of each series. Section four concludes the paper by briefly restating the stylized facts we establish in this study. Two appendices explain the technique for isolating a business cycle component of macroeconomic time series, and provide the cyclical regularities of macroeconomic series after World War II.

II. Data description and statistics summary

More than 50 quarterly macroeconomic time series have been examined in this study.[7] These series consist of six categories: GDP components, aggregate employment,

[7] Each series basically covers the period from 1980:q1 to 2004:q3. Data Sources are: *Annual Report on National Accounts*, Economic and Social Research Institute, Cabinet Office, *Labor Force Survey*, Statistics Bureau, Ministry of Internal Affairs and Communications, *Monthly Labor Survey*, Ministry of Welfare and Labor, and *Financial and Economic Statistics Monthly*, Bank of Japan.

wages, deflators and prices, interest rates and stock price, and money and exchange rate.

In order to characterize the business cycle fluctuations based on the macroeconomic time series, we use several classic statistics: standard deviation and first order auto-correlation of the cyclical component of each series *Xt*, and six orders of cross-correlation of the cyclical component of each series with the cyclical component of real output *gdpt+k*, with the *k* quarter of lead or lag. Standard deviation and cross-correlation of each series tell the scale of its variation and the strength of its relation with the cyclical component of real output respectively. We assume that series *Xt* is pro-cyclical if its cross-correlation is positive and counter-cyclical if its cross-correlation is negative. Moreover, we tend to think that series *Xt* has a lagging property if its maximum correlation appears with lagged real output.

III. Discussion on the stylized facts for Japan

Overall what we have obtained is quite consistent with conventional views on business cycle fluctuations in Japan. With the exception of the labor input series, the results also tend to follow the familiar characteristics of U.S. business cycle fluctuations.[8]

A. GDP components

Consistent with the permanent income hypothesis, private consumption is least

[8] See Rotemberg and Woodford (1996), Stock and Watson (1999), and King and Rebelo (2000) for the stylized facts for the U.S. economy.

volatile; investment, exports, and imports are most volatile. All of the series are pro-cyclical, except for government consumption and public investment (see Table 2).

Private consumption is pro-cyclical, possibly with a lead, implying that private consumption might predict fluctuation in output, rather than output predicting consumption as suggested by the traditional Keynesian model. That consumption might have a significant impact on business cycle has also been pointed out in Motonishi and Yoshikawa (1999). In the 1980s, private consumption played an important role in powering Japan's strong economy. In contrast, since 1991 sluggish consumption due to uncertainty over the future has had a very negative force. Table 3 shows that the cyclical component of private consumption precedes output both before and after 1991.

Private non-residential investment is strongly pro-cyclical with a lag, while interestingly, private residential investment is pro-cyclical with a lead of two quarters.[9] It has an intimate relationship with output in each recovery and recession period. In contrast, public investment is counter-cyclical with a lag. This is because public investment in this period is made as a reaction to stabilize the economy.

Exports are contemporaneously pro-cyclical. Imports are strongly pro-cyclical with a lead of two quarters. Again, as the case with consumption, this implies that imports could predict the movement of output.

B. Aggregate employment

Employment, total hours worked, average hours worked, and labor productivity are

[9] The lagging property of private non-residential investment has also reported in Saito (1997).

pro-cyclical, while unemployment rate is strongly counter-cyclical with a lag of one quarter. The variations of these series are relatively stable (See Table 4).

Employment is pro-cyclical with a lag of two or more quarters.[10] Since a desired change in labor input tends to be accomplished by adjusting hours worked first, instead of the number of employees, employment would be lagged, and also relatively stable even in both the expansionary phase and recessionary phase in Japan.

Average hours worked (total) is pro-cyclical with a lead, scheduled hours worked doesn't show clear cyclicality, and interestingly, non-scheduled hours worked is strongly pro-cyclical with a lead and is very volatile. Again, as Saito (1997) has discussed, at the very beginning of an expansionary phase firms tend to increase non-scheduled hours worked first so as to reach their new levels of production. Therefore the correlation between non-scheduled hours worked and output becomes very strong, and the fluctuation in non-scheduled hours worked is large. In other words, in Japan non-scheduled hours worked has been playing a key role buffering labor inputs, and the timing and magnitude of its change are very important in predicting fluctuations in output.

C. Wages

Cyclicality of wages is a traditional concern of many studies. In consequence we pay particular attention to the cyclical component of wages and examine several different types of series.

[10] Saito (1997) has also pointed out the lagging mechanism of employment adjustments.

Basically, wages are pro-cyclical with a lag of two or three quarters regardless of the type of series. Results also suggest that wages are significantly related to the economic activities in Japan through the non-scheduled cash earnings and bonuses (See Table 5). It is important to note that the strength of the correlation with output in Japan is much larger than what Stock and Watson (1999) find working with U.S. data.[11]

It appears the same mechanism that works for labor inputs also works in hours worked can be applied for wages. Non-scheduled cash earnings are very volatile and clearly pro-cyclical with a lead, while scheduled cash earnings are stable and acyclical. This means wages will be adjusted by non-scheduled cash earnings at the first stage of each expansion and/or recession. The high volatility of bonus payments complements reinforces the impact of non-scheduled cash earnings. The bonuses, unlike contractual cash earnings, are closely related to the firm's performance. Thus, like unscheduled cash earnings, it is adjusted relatively easily. This accounts for the contrast with the U.S. case.

D. Deflators and Prices

Table 6 shows that the contemporaneous correlation coefficients of both the GDP deflator and consumer price index are slightly negative, while as in Yoshizoe et al (2003) the growth rates of these series are pro-cyclical with a lag of three or four quarters, this can be interpreted by the inflation-output tradeoff.

[11] Stock and Watson (1999) conclude that "real wages have essentially no contemporaneous co-movement with the business cycle." by referring the cross-correlation with output. Since the definition of series in each study is different, the statistics should be interpreted with care.

E. Interest rates and stock price

Short-term rates such as call rate, and Tokyo inter-bank offered rate (3 Months) are contemporaneously pro-cyclical, or pro-cyclical with a possible lag. Government bonds and long-term prime lending rate are also pro-cyclical. Stock price is pro-cyclical with a lead of four quarters and most volatile (See Table 7).

F. Money and Exchange rate

Both the level of money stock and monetary base are pro-cyclical with a leading property. At least, in a business cycle sense, there exists a positive relationship between money and output (See Table 8).

An enormous amount of effort has been made to investigate the exact relationship between money and output which is viewed by many as the most important relationship in macroeconomics. A detailed theoretical and empirical discussion on this issue is not the purpose of this paper, but it is useful to look at this relationship in light of the dramatic changes in the economic and monetary environment before and after the collapse of bubble economy in 1991. It is worth asking how the changes that have occurred over this period influenced the character of business cycle fluctuations, and most particularly the relationship between money and output.[12]

[12] Because of our specific interests in Banking behavior, an extra series, that is Bank loan is examined. As we expect, the cyclical component of Bank loan is pro-cyclical with a leading property before 1991, while it has turned into a lagging property since 1991.

First, compare the correlation coefficient of money with output before and after 1991. As expected, in Table 9 it can be seen that the correlation between money and output has weakened since 1991: the maximum correlation coefficient drops from 0.86 to 0.44 for nominal money stock, and from 0.86 to 0.61 for real money stock.

This relationship appears to have changed reflecting an economy awash in liquidity. Indeed, as seen in Table 10, the long-run relationship between money-growth and inflation rate is almost invisible. After 1991, the growth rate of money is negatively correlated with the inflation rate. This is consistent with the recent trend of disinflation in Japan, and is hence, is considered as one of the reasons why the economy had not recovered.

Second, the relationship between monetary base and money stock is examined. Much of the previous literature argues that the money multiplier has been decreasing since 1991 because of concerns about disinflation. According to the results in Table 11a showing the correlation between the level of monetary base and money stock confirms that the relationship obviously weakened since 1991. From the business cycle perspective, it seems that the money multiplier has been decreasing as well. These changes imply that both the propagation mechanisms from monetary base to money stock and from money stock to output have confronted serious problems since 1991.

Now we draw our attention to the impact of monetary policy on the business cycle. Suppose the Bank of Japan (BOJ) can control the growth rate of the monetary base as one of the means for monetary policy, what could we suggest about the effect of monetary policy on money stock or economy? Can BOJ control the growth rate of money stock as well? Table 11b shows that the growth rate of monetary base positively affects the growth rate of money stock. Roughly speaking, it means BOJ

could control the money stock somehow indirectly through the monetary base. However, after 1991, it seems much more difficult to control the money stock via the monetary base, since the correlation coefficient is small and the clear cyclicality present before 1991 disappears.

Still more interesting results are found when Table 9 is examined again. The growth rate of monetary base is counter-cyclical with a lag of one quarter, both before and after 1991. It means that BOJ has basically implemented the counter-cyclical type of monetary policy throughout the period.[13]

Since the growth rate of monetary base is positively correlated with the growth rate of money stock, it is natural to regard money stock-growth as counter-cyclical. Indeed, Table 9 confirms that the growth rate of money stock is counter-cyclical after 1991. We tend to think that the counter-cyclicality of money stock-growth helps to stabilize the economy. However, before 1991, there is no counter-cyclicality of money stock-growth through the monetary base which we typically expect, probably due to the existence of the excess liquidity in economy. Unlike the growth rate of monetary base, the growth rate of money stock has changed its property substantially.

It is also meaningful to note that, after 1991, the growth rate of money stock can be interpreted as both counter-cyclical with a lag (the maximal correlation is -0.41 at k = -1 for nominal), and pro-cyclical with a lead (the maximal correlation is 0.40 at k = 6 for nominal). As we have mentioned before, the first part implies the stabilization mechanism of money stock-growth. The later part means that an increase in the money

[13] As for BOJ's behavior, existing studies including Kasa and Popper (1997) show that BOJ has conducted the counter shocks in response to economy, by interest rate policy and quantitative policy. As seen above, our results also show both call rate and monetary base seem to be offsetting the economic fluctuations.

stock-growth today leads to an increase in output more than one year later with maximum correlation. In sum, the business cycle has a negative impact on the growth rate of money stock, while the growth rate of money stock has a positive impact on the business cycle. One might argue that there exists a positive reverse causality, i.e. the positive effect of business cycle on the growth rate of money stock, however, our results show there exists a negative reverse causality.

At the last part of analyzing the statistical properties in money, we have alternatively implemented the Stock and Watson (1999) type of causality test, particularly concentrating on the relationship between money and output which seems to have changed substantially before and after 1991, to confirm our results from the cross-correlation analysis above.

As in Stock and Watson (1999), the test has been done by computing the marginal R2, assumed to come from regressing of future output onto current and past data on money, given current and past data on output. The results of the test for examining the causality between money and output, which are typically based on two sub-periods covering before and after 1991, are summarized in Table 12. It shows that the Stock and Watson (1999) type of test turns out to be positive in most of cases considered here: in fact, the apparent causality between money and output is confirmed which is to be consistent with the evidences in Stock and Watson (1999).[14] Furthermore, the degree of marginal R2 in money-output relation implies a presence of negative reverse causality, while money-inflation relation is almost invisible.

Effective exchange rate is counter-cyclical with a lag of one quarter. It implies that a

[14] Other major series besides money have also tested. The results show the possible causality in most cases.

depreciation of yen causes an increase in exports, in turn grows economy. Considering the features of both exports and exchange rate together, one might say that in Japan output helps to predict exports, rather than exports leading output.

IV. Conclusions

This paper characterizes business cycle fluctuations in Japan since 1980 to the present. Stock and Watson (1999) present robust stylized facts for the American economy. In an effort to provide a cross-national perspective, this paper presents analogous information for Japan. The results for the individual series are, (i) private consumption is least volatile; both private and public investment, exports, and imports are most volatile, (ii) employment, total hours worked, average hours worked (total), and labor productivity are less volatile, (iii) non-scheduled hours worked is much more volatile, implying it has been playing an important role as a buffer in labor input, (iv) non-scheduled wage is much more volatile, while scheduled wage is considerably stable, (v) both GDP deflator and consumer price index are less volatile, (vi) interest rates are less volatile regardless of its duration, and (vii) money is more volatile than output.

As regards cyclicality, (i) private consumption and private residential investment are pro-cyclical with a lead, while private non-residential investment is pro-cyclical with a lag, (ii) Public investment is counter-cyclical with a lag, (iii) both exports and imports are pro-cyclical, (iv) employment is pro-cyclical with a lag, while average hours worked (total) is pro-cyclical with a lead, (v) wage is essentially pro-cyclical with a lag, (vi) inflation rate measured by GDP deflator and consumer price index are pro-cyclical with a lag, (vii) basically money is pro-cyclical with a lead, while the growth rate of money

is counter-cyclical with a lag, although some properties of money have been changed since 1991 with important policy consequences, and (viii) effective exchange rate is counter-cyclical with a lag, that is, the depreciation of yen is positively correlated with output.

Taken as a whole, we believe that our findings may be useful for stimulating new studies on Japan's business cycle.

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Appendix 1

In this appendix, we briefly review the technique for isolating a business cycle component of macroeconomic time series which lies in a certain band of frequency, by introducing the approximate band-pass filter, one of the most broadly used in modern business cycle studies, developed in Baxter and King (1999) and Christiano and Fitsgerald (2003).[15]

Band-pass filter is a linear filter which retains the cyclical component of each series within a specific band of frequency, and removes other components. It can be applied, therefore, to decompose a series into its low, high and remaining intermediate frequencies, which have been considered as trend, irregular, and business cycle component respectively, so as to distinguish between a business cycle component and other components.

Figure 1 in appendix 1 displays each component of real output along with the logarithm of its original series: Business cycle component follows the main stream of the Japanese business cycles. Trend component is much smoother than original series because of removing the irregular and business cycle component. On the other hand, irregular component is less volatile, but moves quickly comparing with other components.

Frequency domain analysis applying the band-pass filter is basically relying on the idea of Fourier transformation. Let *yt* be a filtered series of *xt*, an original and

[15] There are some other techniques designed for de-trending and smoothing: removing liner trends, differencing, and the Hodrick-Prescott (1980) filter. See Baxter and King (1999) for detailed comparison among these filters.

pre-filtered series:

$$y_t = B(L)\ x_t.$$

The band-pass filter *B(L)*, which is an ideal moving average with symmetric weights, has the following properties:

$$B(L) = \sum_{k=-\infty}^{\infty} B_k L^k,$$

where *L* denotes lag operator and $B_k = B_{-k}$ for all *k*.

The filter can be expressed as the frequency response function based on Fourier representation:

$$B(e^{-i\lambda}) = B_0 + B_1 e^{-i\lambda} + B_2 e^{-i2\lambda} +, \qquad ,+B_k e^{-ik\lambda},$$

where $e^{-i\lambda} = \cos\lambda - i\sin\lambda.$

In order to isolate desired frequency in the series, here we assume that the frequency response function is one for our desirable band of frequency, while zero for else. That is,

$$B(e^{-i\lambda}) = \begin{cases} 1 & if\ \lambda \in \left[(\underline{\lambda}, \overline{\lambda}) \cup (-\overline{\lambda}, -\underline{\lambda})\right], \qquad \lambda \in [-\pi, \pi] \\ 0 & otherwise \end{cases}$$

where $\underline{\lambda}$ denotes low cut frequency and $\overline{\lambda}$ denotes high cut frequency.[16]

Then, we can extract a business cycle component by band-pass filtering in the frequency domain. As discussed in Baxter and King (1999) and Christiano and Fitsgerald (2003), technically we are required to have an infinite number of observations to construct the band-pass filter, therefore the approximate band-pass filter has been applied in this study, with two imposed conditions, that is the filter's weights sum to zero and the filter is symmetric on leads and lags.

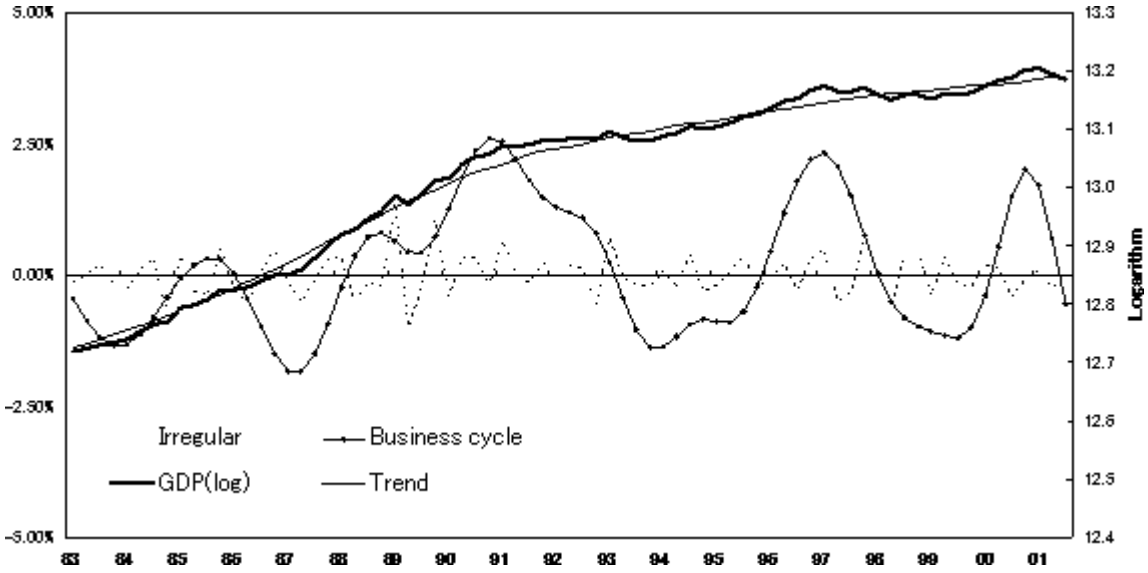
[16] Since we define the business cycle as fluctuations between six and thirty-two quarters in time domain, we apply $\underline{\lambda} = |2\pi/32|$ and $\overline{\lambda} = |2\pi/6|$ in frequency domain.

APPENTDIX 1 TABLE 1. Weights For Business Cycle Filters

Lag weights for the BP(6,32) filter with k=12												
k												
0	1	2	3	4	5	6	7	8	9	10	11	12
0.277	0.220	0.084	-0.052	-0.119	-0.102	-0.042	0.001	0.001	-0.028	-0.050	-0.043	-0.012

APPENTDIX 1 FIGURE 1.

Business Cycle, Trend And Irregular Component Of Real Output In Japan



Note: The filtered series are obtained using the approximate band-pass filter in the GAUSS program.

Appendix 2

This paper documents the robust stylized facts for recent business cycle fluctuations in Japan. In this appendix, we additionally study the period 1955:q1-2002:q1, applying quarterly data on major aggregate series including real output and its components, inputs to production and nominal variables such as money stock.

Table 1 in appendix 2 summarizes the statistical properties of cyclical component. Our findings confirm the cyclical regularities in the properties of series after World War II are mostly consistent with those for the past two decades: private consumption is least volatile; both private and public investment, exports, and imports are most volatile. The cyclical properties of GDP components are also quite similar, with the possible exceptions of private consumption and public investment: private consumption has a clear lagging property, and public investment is pro-cyclical with a lead rather than counter-cyclical with a lag.

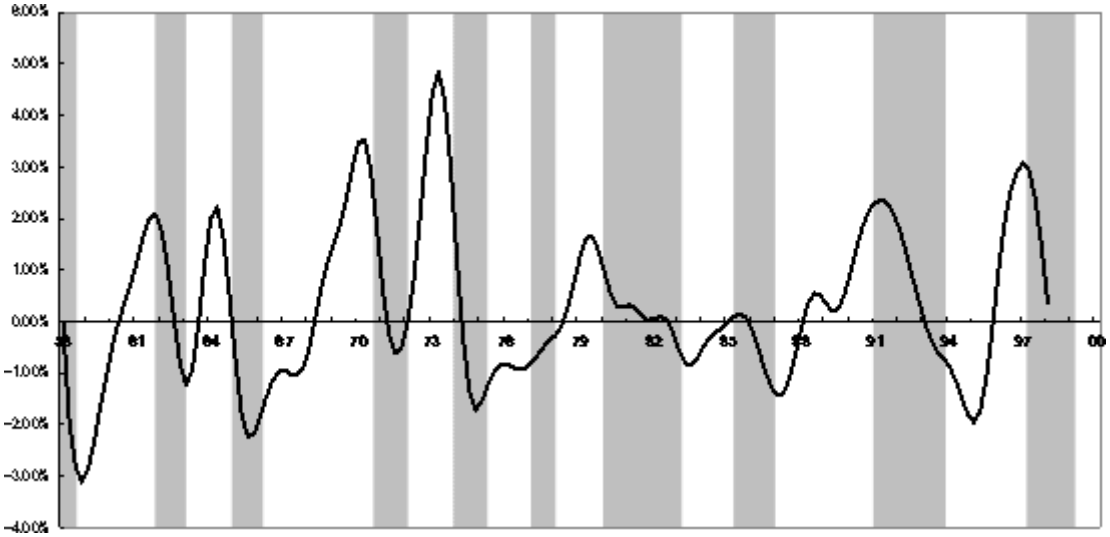
As regards production inputs, employment, total hours worked, average hours worked (total), and labor productivity are relatively stable. Moreover employment is pro-cyclical with a lag, while average hours worked (total) is pro-cyclical with a lead. The behavior of nominal variables is also consistent: money is more volatile and pro-cyclical with a lead, while inflation rate measured by GDP deflator and consumer price index is pro-cyclical with a lag and wages are weakly pro-cyclical with a lag. The negative reverse causality between money stock-growth and output is also observed.

In terms of discrepancies due to including the period enjoying rapid economic growth in the mid-1900s, the significant is perhaps that the relatively high volatilities of prices caused by the oil crises in the 1970s.

APPENTDIX 2 TABLE 1. Statistics Summary For Cyclical Component After World War II

Macroeconomic time series				**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
	Std. Dev.	**Relative Std. Dev.**	**Auto-correlation**	**k**												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Gross Domestic Product	1.53%	1.00	0.93	-0.10	0.05	0.26	0.51	0.75	0.93	1.00	0.93	0.75	0.51	0.26	0.05	-0.10
GDP components																
Private Consumption	1.21%	0.79	0.91	-0.18	-0.07	0.09	0.31	0.54	0.73	0.83	0.80	0.67	0.47	0.25	0.06	-0.08
Private Residential Investment	5.87%	3.83	0.89	-0.40	-0.33	-0.18	0.02	0.23	0.40	0.50	0.51	0.46	0.36	0.25	0.15	0.08
Private Non-Resi. Investment	6.71%	4.38	0.94	-0.03	0.17	0.40	0.61	0.77	0.85	0.83	0.71	0.53	0.34	0.16	0.02	-0.07
Government Consumption	1.12%	0.73	0.85	-0.14	-0.28	-0.36	-0.35	-0.26	-0.13	0.02	0.11	0.16	0.17	0.16	0.14	0.12
Public Investment	4.98%	3.25	0.90	0.10	-0.03	-0.11	-0.14	-0.09	0.01	0.12	0.21	0.25	0.25	0.21	0.16	0.10
Exports	4.18%	2.73	0.89	0.18	0.26	0.30	0.28	0.22	0.13	0.04	-0.04	-0.07	-0.07	-0.05	-0.01	0.02
Imports	6.17%	4.02	0.90	-0.13	0.01	0.16	0.32	0.47	0.58	0.65	0.62	0.52	0.38	0.22	0.10	0.02
Aggregate employment, Wages																
Regular Employment Index	1.09%	0.71	0.96	0.30	0.41	0.50	0.56	0.56	0.51	0.42	0.30	0.17	0.06	-0.02	-0.08	-0.11
Total Hours Worked	1.35%	0.88	0.94	-0.11	0.03	0.20	0.37	0.52	0.61	0.64	0.59	0.49	0.37	0.25	0.15	0.08
Average Hours Worked Index(total)	0.80%	0.52	0.93	-0.60	-0.51	-0.35	-0.13	0.11	0.33	0.50	0.58	0.59	0.54	0.45	0.36	0.28
Labor Productivity	1.24%	0.81	0.93	0.01	0.04	0.11	0.22	0.36	0.47	0.52	0.49	0.38	0.22	0.04	-0.10	-0.20
Wage Index(Total cash earnings, nominal)	1.90%	1.24	0.96	0.30	0.32	0.30	0.25	0.17	0.08	-0.03	-0.13	-0.22	-0.28	-0.31	-0.31	-0.28
Deflators and Prices																
GDP deflator(level)	1.75%	1.14	0.93	0.21	0.24	0.22	0.14	0.03	-0.10	-0.21	-0.30	-0.37	-0.41	-0.40	-0.37	-0.30
GDP deflator(growth rate)	2.22%	1.45	0.88	0.22	0.36	0.42	0.41	0.34	0.23	0.10	-0.03	-0.14	-0.24	-0.30	-0.32	-0.29
Consumer Price Index(level)	2.04%	1.33	0.95	0.33	0.30	0.21	0.07	-0.10	-0.26	-0.38	-0.46	-0.48	-0.46	-0.41	-0.34	-0.26
Consumer Price Index(growth rate)	2.44%	1.59	0.91	0.44	0.56	0.58	0.50	0.35	0.16	-0.02	-0.17	-0.26	-0.31	-0.31	-0.28	-0.24
Money																
Money Stock(M2+CD, nominal)	1.69%	1.11	0.95	0.02	0.04	0.09	0.17	0.26	0.34	0.40	0.40	0.34	0.23	0.09	-0.06	-0.19
Money Stock(M2+CD, nominal, growth rate)	2.01%	1.31	0.89	-0.25	-0.30	-0.30	-0.23	-0.10	0.08	0.26	0.42	0.50	0.50	0.41	0.28	0.15
Money Stock(M2+CD, real)	2.53%	1.65	0.94	-0.14	-0.14	-0.09	0.02	0.15	0.29	0.41	0.48	0.49	0.44	0.34	0.21	0.08
Money Stock(M2+CD, real, growth rate)	3.22%	2.10	0.89	-0.27	-0.39	-0.44	-0.40	-0.29	-0.12	0.07	0.24	0.37	0.44	0.45	0.39	0.29

APPENTDIX 2 FIGURE 1. Filtered Real GDP After Word War II



Note: The filtered series are obtained using the approximate band-pass filter in the GAUSS program.

TABLE 1. Business Cycle History In Japan

Peak	Trough	Business cycle/ its duration in month
1951 II	1951 IV	-
1954 I	1954 IV	37
1957 II	1958 II	43
1961 IV	1962 IV	52
1964 IV	1965 IV	36
1970 III	1971 IV	74
1973 IV	1975 I	39
1977 I	1977 IV	31
1980 I	1983 I	64
1985 II	1986 IV	45
1991 I	1993 IV	83
1997 II	1999 I	63
2000 IV	2002 I	36

Note: Peaks and Troughs have been determined by ESRI, Cabinet Office.

TABLE 2. Statistics Summary For Cyclical Component: GDP components

Macroeconomic time series				**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
	Std. Dev.	**Relative Std. Dev.**	**Auto-correlation**	**k**												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Gross Domestic Product	1.23%	1.00	0.93	-0.04	0.11	0.30	0.53	0.76	0.93	1.00	0.93	0.76	0.53	0.30	0.11	-0.04
GDP components																
Private Consumption	0.68%	0.55	0.92	0.08	0.18	0.29	0.42	0.55	0.68	0.76	0.77	0.70	0.56	0.39	0.22	0.10
Consumption(Households)	0.71%	0.58	0.92	0.05	0.16	0.28	0.42	0.57	0.70	0.78	0.78	0.70	0.55	0.37	0.21	0.08
Consumption(Excluding Imputed Rent)	0.83%	0.68	0.92	0.00	0.12	0.25	0.39	0.55	0.69	0.78	0.79	0.71	0.57	0.39	0.22	0.09
Private Residential Investment	6.13%	5.00	0.91	-0.41	-0.41	-0.34	-0.19	0.02	0.25	0.44	0.56	0.60	0.57	0.49	0.41	0.34
Private Non-Resi. Investment	5.58%	4.55	0.94	0.06	0.25	0.46	0.67	0.83	0.91	0.88	0.75	0.56	0.35	0.16	0.01	-0.10
Change in Private Inventory(Relative to GDP)	0.24%	0.19	0.87	-0.36	-0.15	0.09	0.34	0.55	0.69	0.73	0.64	0.51	0.37	0.26	0.16	0.06
Government Consumption	0.89%	0.73	0.92	-0.33	-0.34	-0.30	-0.23	-0.14	-0.05	0.04	0.14	0.22	0.30	0.35	0.36	0.31
Public Investment	4.23%	3.44	0.88	0.05	-0.11	-0.27	-0.38	-0.42	-0.39	-0.31	-0.19	-0.07	0.04	0.12	0.16	0.16
Change in Public Inventory(Relative to GDP)	0.04%	0.03	0.83	-0.18	-0.18	-0.16	-0.11	-0.03	0.06	0.13	0.14	0.09	0.02	-0.07	-0.14	-0.18
Exports	3.84%	3.13	0.86	-0.08	0.00	0.09	0.20	0.32	0.44	0.53	0.51	0.39	0.21	0.01	-0.18	-0.34
Imports	5.28%	4.30	0.94	-0.34	-0.23	-0.08	0.10	0.31	0.52	0.71	0.83	0.86	0.82	0.72	0.56	0.37
Trade Balance(Relative to GDP)	0.38%	0.31	0.91	0.27	0.21	0.12	0.01	-0.10	-0.20	-0.27	-0.38	-0.50	-0.61	-0.67	-0.67	-0.61
Gross domestic fixed capital formation	3.11%	2.53	0.94	-0.06	0.08	0.26	0.48	0.71	0.87	0.94	0.90	0.76	0.59	0.41	0.24	0.10

TABLE 3. Cross-correlation Of Consumption With Output, Before And After 1991

Consumption	**Std. Dev.**	**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
		k												
		-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
1. Before 1991: 1985:q2-1991:q1														
Private Consumption	0.74%	0.12	0.15	0.22	0.36	0.54	0.75	0.92	0.94	0.84	0.64	0.41	0.20	0.08
2. After 1991 : 1991:q1- 2001:q3														
Private Consumption	0.66%	-0.27	-0.11	0.07	0.24	0.41	0.56	0.68	0.68	0.60	0.45	0.26	0.06	-0.10

TABLE 4. Statistics Summary For Cyclical Component: Aggregate employment

Macroeconomic time series	**Std. Dev.**	**Relative Std. Dev.**	**Auto-correlation**	**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
				k												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Aggregate employment																
Labor Force	0.34%	0.28	0.94	0.56	0.62	0.65	0.65	0.60	0.49	0.33	0.16	0.00	-0.15	-0.27	-0.36	-0.44
Total Employed	0.44%	0.36	0.94	0.48	0.59	0.68	0.74	0.75	0.69	0.57	0.39	0.19	-0.01	-0.19	-0.34	-0.44
Employees	0.59%	0.48	0.95	0.44	0.54	0.63	0.68	0.68	0.62	0.47	0.27	0.04	-0.16	-0.33	-0.44	-0.51
Regular Employment Index	0.64%	0.52	0.97	0.69	0.66	0.61	0.52	0.40	0.26	0.10	-0.05	-0.18	-0.28	-0.35	-0.39	-0.40
Total Hours Worked	0.51%	0.42	0.93	0.20	0.28	0.36	0.46	0.57	0.68	0.77	0.77	0.69	0.53	0.33	0.12	-0.07
Average Hours Worked Index(total)	0.66%	0.54	0.94	-0.51	-0.42	-0.30	-0.15	0.05	0.28	0.49	0.64	0.71	0.69	0.60	0.47	0.34
Average Hours Worked Index(Scheduled)	0.43%	0.35	0.92	-0.52	-0.51	-0.48	-0.41	-0.28	-0.09	0.13	0.34	0.48	0.54	0.52	0.46	0.39
Average Hours Worked Index(Non-scheduled)	4.70%	3.83	0.93	-0.35	-0.20	-0.01	0.20	0.43	0.62	0.76	0.80	0.75	0.65	0.50	0.34	0.17
Ratio of Unemployed in Labor Force	0.16%	0.13	0.91	-0.14	-0.31	-0.48	-0.64	-0.77	-0.83	-0.81	-0.68	-0.48	-0.26	-0.04	0.14	0.28
Effective Job Offer Rate	13.03%	10.62	0.95	-0.10	0.06	0.26	0.48	0.68	0.83	0.90	0.88	0.77	0.61	0.43	0.23	0.03
New Job offers	7.93%	6.46	0.94	-0.26	-0.12	0.06	0.28	0.50	0.69	0.82	0.85	0.78	0.65	0.48	0.31	0.15
Index of Capacity Utilization Ratio (Manu.)	3.30%	2.69	0.86	-0.37	-0.27	-0.11	0.09	0.31	0.52	0.69	0.73	0.67	0.56	0.41	0.26	0.12
Labor Productivity	0.90%	0.73	0.91	-0.17	-0.01	0.21	0.46	0.71	0.88	0.93	0.83	0.64	0.42	0.23	0.08	-0.02

TABLE 5. Statistics Summary For Cyclical Component: Wages

Macroeconomic time series				**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
	Std. Dev.	**Relative Std. Dev.**	**Auto-correlation**	**k**												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Wages																
Wage Index(Total cash earnings, nominal)	0.73%	0.59	0.94	0.22	0.40	0.57	0.71	0.79	0.78	0.69	0.54	0.36	0.16	-0.04	-0.22	-0.37
Wage Index(Contractual cash earnings, nom)	0.42%	0.34	0.92	0.00	0.12	0.27	0.44	0.57	0.64	0.62	0.51	0.36	0.18	0.00	-0.16	-0.30
Wage Index(Total cash earnings, nom, growth rate)	0.83%	0.67	0.90	-0.48	-0.30	-0.07	0.17	0.39	0.56	0.67	0.71	0.68	0.59	0.45	0.30	0.15
Wage Index(Total cash earnings, real)	0.79%	0.64	0.93	-0.32	-0.14	0.07	0.28	0.47	0.60	0.66	0.68	0.65	0.58	0.47	0.35	0.23
Wage Index(Contractual cash earnings, real)	0.72%	0.59	0.94	-0.58	-0.50	-0.35	-0.16	0.04	0.24	0.38	0.49	0.56	0.57	0.55	0.51	0.45
Wage Index(Total cash earnings, real, growth rate)	0.89%	0.73	0.89	-0.71	-0.66	-0.54	-0.38	-0.19	-0.01	0.16	0.29	0.38	0.41	0.39	0.35	0.32
Wage(Total cash earnings)	1.11%	0.91	0.74	0.28	0.44	0.55	0.60	0.58	0.50	0.39	0.27	0.13	-0.02	-0.16	-0.28	-0.36
Wage(Contractual cash earnings)	0.67%	0.54	0.91	0.17	0.31	0.40	0.44	0.43	0.36	0.26	0.16	0.04	-0.08	-0.20	-0.29	-0.35
Wage(Scheduled cash earnings)	0.71%	0.58	0.90	0.36	0.41	0.41	0.34	0.21	0.05	-0.12	-0.25	-0.34	-0.41	-0.46	-0.47	-0.45
Wage(Non-scheduled cash earnings)	4.05%	3.30	0.93	-0.33	-0.17	0.03	0.24	0.45	0.63	0.75	0.77	0.72	0.60	0.45	0.29	0.13
Wage(others, including bonus)	4.70%	3.83	0.59	0.24	0.41	0.54	0.61	0.59	0.51	0.37	0.24	0.11	-0.03	-0.14	-0.22	-0.27
Wage(Total cash earnings, growth rate)	1.31%	1.07	0.88	-0.24	-0.01	0.18	0.33	0.42	0.47	0.48	0.47	0.42	0.33	0.20	0.08	-0.02
Compensation of Employees(nominal)	1.21%	0.99	0.95	0.42	0.57	0.69	0.76	0.77	0.70	0.56	0.37	0.17	-0.03	-0.21	-0.35	-0.47
Compensation of Employees(nom, growth rate)	1.32%	1.08	0.91	-0.29	-0.07	0.17	0.40	0.58	0.70	0.75	0.72	0.63	0.51	0.38	0.23	0.08
Compensation of Employees(real)	0.93%	0.76	0.93	0.17	0.38	0.59	0.76	0.86	0.86	0.76	0.61	0.43	0.24	0.06	-0.09	-0.20
Compensation of Employees(real, growth rate)	1.10%	0.90	0.90	-0.56	-0.38	-0.14	0.12	0.35	0.53	0.62	0.62	0.56	0.47	0.36	0.25	0.16

TABLE 6. Statistics Summary For Cyclical Component: Deflators and Prices

Macroeconomic time series	Std. Dev.	Relative Std. Dev.	Auto-correlation	Cross-correlation with GDP (Corr[xt, gdpt+k]) k												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Deflators and Prices																
GDP deflator(level)	0.66%	0.54	0.95	0.62	0.61	0.53	0.39	0.22	0.04	-0.12	-0.26	-0.36	-0.43	-0.48	-0.52	-0.53
GDP deflator(growth rate)	0.70%	0.57	0.91	0.43	0.59	0.67	0.67	0.58	0.46	0.33	0.22	0.13	0.05	-0.03	-0.12	-0.20
Consumer Price Index(level)	0.78%	0.64	0.96	0.53	0.52	0.47	0.38	0.27	0.13	-0.02	-0.18	-0.32	-0.44	-0.51	-0.56	-0.58
Consumer Price Index(growth rate)	0.80%	0.66	0.91	0.30	0.43	0.53	0.60	0.61	0.58	0.51	0.40	0.27	0.15	0.03	-0.09	-0.21
Domestic Corporate Goods Price Index(level)	1.25%	1.01	0.94	0.15	0.22	0.29	0.35	0.39	0.41	0.39	0.32	0.22	0.08	-0.07	-0.23	-0.38
Domestic Corporate Goods Price Index(growth)	1.42%	1.16	0.87	-0.16	-0.10	-0.02	0.07	0.18	0.30	0.42	0.51	0.55	0.53	0.44	0.31	0.16

TABLE 7. Statistics Summary For Cyclical Component: Interest rates and Stock price

Macroeconomic time series	Std. Dev.	Relative Std. Dev.	Auto-correlation	Cross-correlation with GDP (Corr[xt, gdpt+k]) k												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Interest rates and stock price																
Call Rates(Collateralized Overnight)	0.89%	0.72	0.95	0.19	0.26	0.35	0.43	0.50	0.53	0.53	0.48	0.39	0.28	0.15	0.04	-0.06
Tokyo Interbank Offered Rates(3 Months)	0.81%	0.66	0.94	0.17	0.23	0.30	0.38	0.46	0.52	0.53	0.50	0.41	0.30	0.19	0.08	-0.01
Newly Issued Government Bonds (10 Years)	0.48%	0.39	0.91	0.01	-0.02	0.00	0.08	0.22	0.38	0.52	0.58	0.57	0.49	0.36	0.21	0.07
Long-term Prime Lending Rate	0.57%	0.47	0.92	0.23	0.23	0.26	0.32	0.41	0.48	0.51	0.47	0.38	0.25	0.14	0.05	-0.01
Interest Rate Spread	0.51%	0.42	0.90	-0.26	-0.38	-0.47	-0.53	-0.52	-0.46	-0.36	-0.24	-0.12	-0.02	0.04	0.07	0.08
Stock Price	11.76%	9.58	0.90	-0.40	-0.36	-0.31	-0.25	-0.17	-0.03	0.15	0.34	0.50	0.62	0.65	0.60	0.49

TABLE 8. Statistics Summary For Cyclical Component: Money and Exchange rate

Macroeconomic time series				**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
	Std. Dev.	**Relative Std. Dev.**	**Auto-correlation**	**k**												
				-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Money and Exchange rate																
Money Stock(M2+CD, nominal)	1.51%	1.23	0.97	0.27	0.31	0.36	0.41	0.47	0.53	0.58	0.62	0.62	0.59	0.53	0.44	0.34
Money Stock(M2+CD, nominal, growth rate)	1.43%	1.17	0.91	-0.28	-0.30	-0.30	-0.27	-0.20	-0.08	0.06	0.20	0.32	0.41	0.46	0.49	0.50
Money Stock(M2+CD, real)	1.68%	1.37	0.96	-0.01	0.04	0.12	0.22	0.34	0.46	0.57	0.65	0.70	0.70	0.67	0.60	0.51
Money Stock(M2+CD, real, growth rate)	1.61%	1.31	0.90	-0.44	-0.53	-0.57	-0.54	-0.44	-0.28	-0.10	0.07	0.22	0.34	0.42	0.48	0.53
Monetary Base(nominal)	2.72%	2.21	0.91	0.28	0.27	0.21	0.12	0.06	0.05	0.13	0.25	0.35	0.40	0.39	0.34	0.29
Monetary Base(nominal, growth rate)	2.89%	2.35	0.84	0.05	0.02	-0.08	-0.21	-0.32	-0.35	-0.26	-0.07	0.10	0.21	0.23	0.21	0.18
Effective Exchange Rates	7.38%	6.01	0.93	-0.25	-0.34	-0.41	-0.47	-0.50	-0.51	-0.48	-0.42	-0.32	-0.17	0.00	0.17	0.32

TABLE 9. Cross-correlation Of Money With Output, Before and After 1991

Money		**Cross-correlation with GDP (Corr[xt, gdpt+k])**												
	Std. Dev.	**k**												
		-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
1. Before 1991: 1985:q2-1991:q1														
Money Stock(M2+CD, nominal)	2.25%	0.17	0.20	0.26	0.36	0.51	0.69	0.85	0.86	0.79	0.66	0.49	0.33	0.20
Money Stock(M2+CD, nom, growth rate)	1.58%	0.12	0.07	0.01	0.02	0.12	0.31	0.53	0.78	0.84	0.71	0.50	0.29	0.17
Money Stock(M2+CD, real)	2.52%	0.00	0.03	0.10	0.21	0.39	0.59	0.78	0.86	0.85	0.77	0.65	0.52	0.41
Money Stock(M2+CD, real, growth rate)	1.58%	-0.03	-0.17	-0.28	-0.31	-0.23	-0.04	0.20	0.50	0.61	0.54	0.41	0.29	0.25
Monetary Base(nominal)	2.65%	0.02	0.08	0.13	0.20	0.30	0.44	0.61	0.72	0.80	0.83	0.79	0.70	0.56
Monetary Base(nominal, growth rate)	1.91%	0.03	0.02	-0.07	-0.21	-0.33	-0.38	-0.31	-0.01	0.27	0.49	0.60	0.61	0.53
2. After 1991 : 1991:q1- 2001:q3														
Money Stock(M2+CD, nominal)	1.15%	0.08	0.13	0.19	0.25	0.31	0.37	0.44	0.38	0.34	0.30	0.25	0.17	0.06
Money Stock(M2+CD, nom, growth rate)	1.11%	-0.29	-0.32	-0.33	-0.35	-0.39	-0.41	-0.35	-0.25	-0.10	0.06	0.21	0.32	0.40
Money Stock(M2+CD, real)	1.07%	-0.31	-0.25	-0.13	0.03	0.22	0.41	0.60	0.61	0.60	0.58	0.52	0.41	0.24
Money Stock(M2+CD, real, growth rate)	1.37%	-0.42	-0.53	-0.59	-0.62	-0.61	-0.56	-0.42	-0.25	-0.06	0.12	0.28	0.41	0.49
Monetary Base(nominal)	2.76%	0.38	0.33	0.21	0.05	-0.09	-0.13	-0.03	0.04	0.10	0.10	0.04	-0.05	-0.14
Monetary Base(nominal, growth rate)	3.12%	0.21	0.18	0.07	-0.11	-0.29	-0.39	-0.33	-0.13	0.02	0.08	0.03	-0.05	-0.10

TABLE 10. Cross-correlation Between Money-Growth And Inflation rate

Inflation rate	Cross-correlation with Money Stock(nominal, growth rate) (Corr[xt, ΔMSt+k])												
	k												
	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
1. Full period													
GDP deflator(growth rate)	0.44	0.39	0.29	0.16	0.05	-0.02	-0.04	-0.04	-0.05	-0.11	-0.22	-0.35	-0.45
Consumer Price Index(growth rate)	0.35	0.36	0.34	0.29	0.21	0.14	0.09	0.05	-0.01	-0.10	-0.23	-0.37	-0.48
2. Before 1991: 1985:q2-1991:q1													
GDP deflator(growth rate)	0.38	0.34	0.30	0.26	0.24	0.24	0.24	0.33	0.35	0.26	0.09	-0.08	-0.19
Consumer Price Index(growth rate)	0.31	0.36	0.43	0.48	0.49	0.45	0.35	0.35	0.32	0.21	0.03	-0.17	-0.29
3. After 1991 : 1991:q1- 2001:q3													
GDP deflator(growth rate)	0.11	0.07	0.04	0.00	-0.05	-0.12	-0.18	-0.24	-0.27	-0.29	-0.32	-0.34	-0.32
Consumer Price Index(growth rate)	0.13	0.11	0.08	0.05	0.00	-0.05	-0.09	-0.14	-0.15	-0.16	-0.20	-0.23	-0.25

TABLE 11a. Cross-correlation Between Monetary Base And Money Stock (Level)

Money Stock(level)	Cross-correlation with Monetary Base (Corr[xt, MBt+k])												
	k												
	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
1. Full period													
Money Stock(nominal)	0.42	0.49	0.55	0.59	0.62	0.62	0.60	0.55	0.47	0.37	0.26	0.15	0.06
Money Stock(real)	0.27	0.37	0.45	0.52	0.57	0.59	0.58	0.54	0.49	0.43	0.37	0.31	0.24
2. Before 1991: 1985:q2-1991:q1													
Money Stock(nominal)	0.37	0.51	0.65	0.78	0.87	0.91	0.88	0.74	0.56	0.37	0.20	0.07	-0.02
Money Stock(real)	0.26	0.42	0.59	0.75	0.88	0.94	0.95	0.83	0.68	0.51	0.36	0.24	0.16
3. After 1991 : 1991:q1- 2001:q3													
Money Stock(nominal)	-0.05	0.00	0.06	0.14	0.21	0.30	0.39	0.34	0.27	0.18	0.07	-0.03	-0.10
Money Stock(real)	-0.13	-0.09	-0.04	0.00	0.04	0.09	0.16	0.11	0.08	0.05	0.02	-0.02	-0.04

TABLE 11b. Cross-correlation Between Monetary Base And Money Stock (Growth)

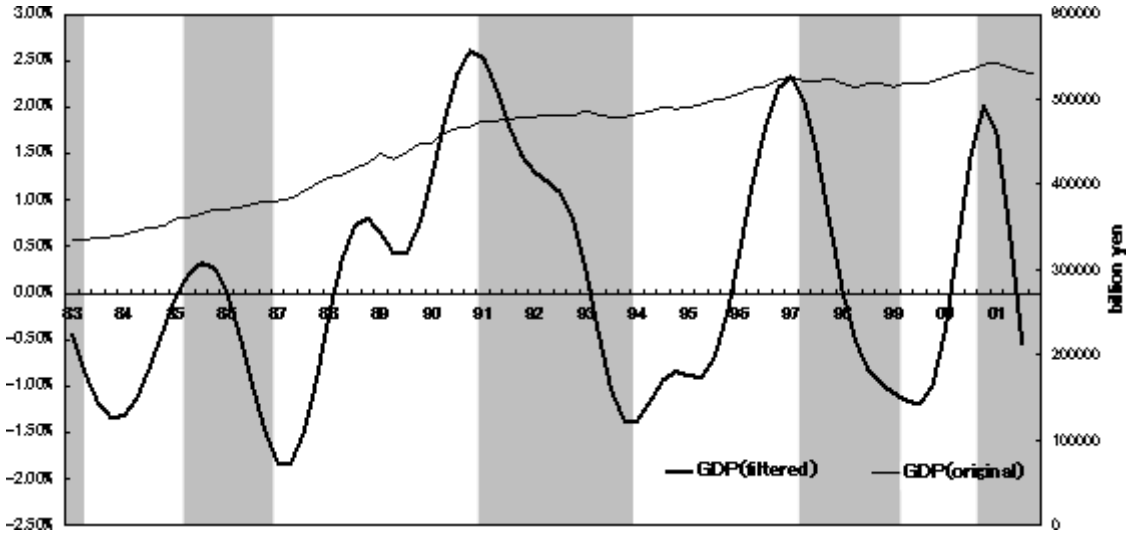
Money Stock(growth rate)	**Cross-correlation with Monetary Base(growth rate) (Corr[xt, ΔMBt+k])**												
	k												
	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
1. Full period													
Money Stock(nominal, growth rate)	0.17	0.26	0.34	0.40	0.43	0.45	0.43	0.36	0.25	0.12	0.02	-0.06	-0.10
Money Stock(real, growth rate)	0.04	0.16	0.29	0.39	0.46	0.45	0.39	0.28	0.18	0.10	0.05	0.03	0.01
2. Before 1991: 1985:q2-1991:q1													
Money Stock(nominal, growth rate)	0.03	0.20	0.36	0.51	0.60	0.60	0.47	0.10	-0.21	-0.36	-0.34	-0.23	-0.11
Money Stock(real, growth rate)	-0.11	0.11	0.34	0.56	0.70	0.71	0.56	0.12	-0.21	-0.34	-0.28	-0.13	0.00
3. After 1991 : 1991:q1- 2001:q3													
Money Stock(nominal, growth rate)	0.32	0.35	0.32	0.25	0.20	0.20	0.25	0.28	0.26	0.20	0.10	0.00	-0.09
Money Stock(real, growth rate)	0.18	0.22	0.24	0.24	0.21	0.18	0.15	0.13	0.11	0.08	0.04	-0.01	-0.07

TABLE 12. Results From The Stock and Watson Type Of Predictive Regressions

	Marginal R^2 from the Stock and Watson type of Predictive Regressions					
	Money Stock → GDP	GDP → Money Stock	Monetary Base → GDP	GDP → Monetary Base	Money Stock → GDP deflator	GDP deflator → Money Stock
1. Full period	0.10	0.01	0.10	0.04	0.00	0.00
2. Before 1991: 1985:q2-1991:q1	0.07	0.01	0.15	0.01	0.00	0.02
3. After 1991 : 1991:q1- 2001:q3	0.22	0.09	0.15	0.06	0.01	0.04

Note: The marginal R^2 is obtained by the difference in R^2 of two regressions: the regression of Δy_t onto $(x_t, \cdots x_{t-4})$ conditional on, $(\Delta y_t, \cdots \Delta y_{t-4})$ and the regression of Δy_t onto $(\Delta y_t, \cdots \Delta y_{t-4})$, applying the logarithms of the original series.

FIGURE 1. Original And Filtered Real GDP

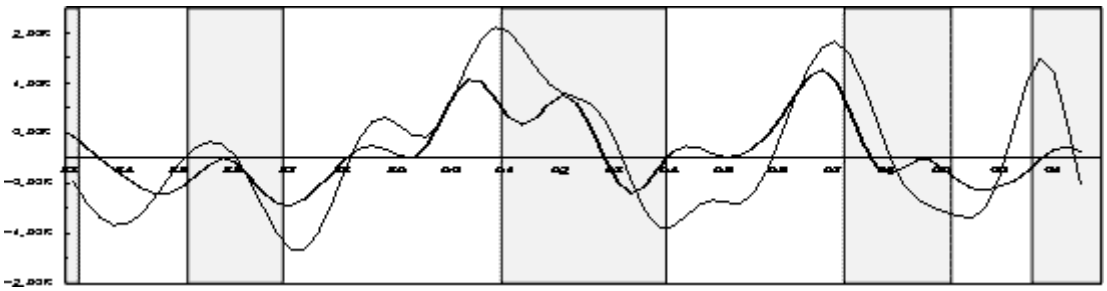


Note: The filtered series are obtained using the approximate band-pass filter in the GAUSS program.

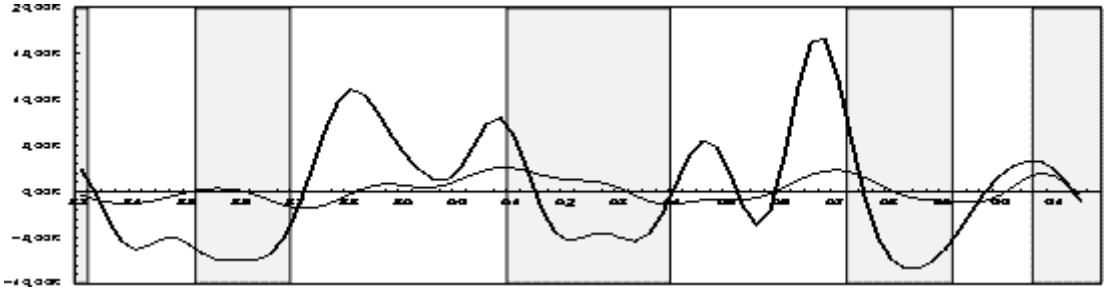
FIGURE 2. Cyclical Component Of Selected Series: 1980:q1-2004:q3

thin line: GDP thick line: individual series

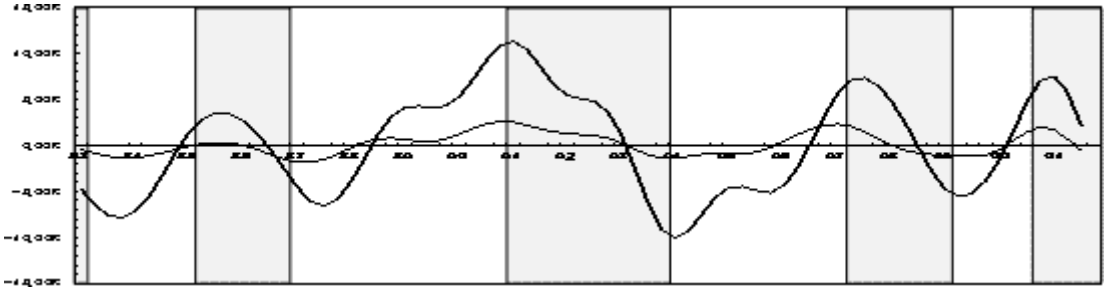
2-1: Private Consumption



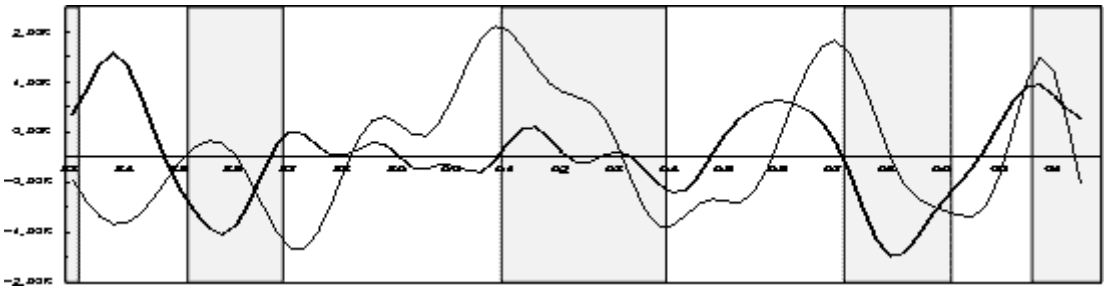
2-2: Private Residential Investment



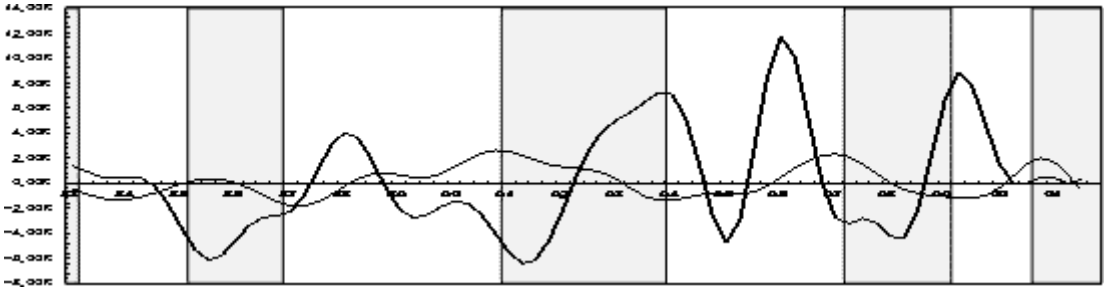
2-3: Private Non-Resi. Investment



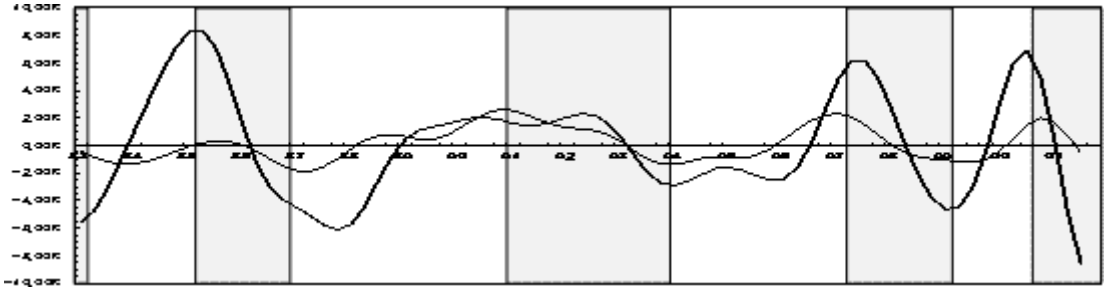
2-4: Government Consumption



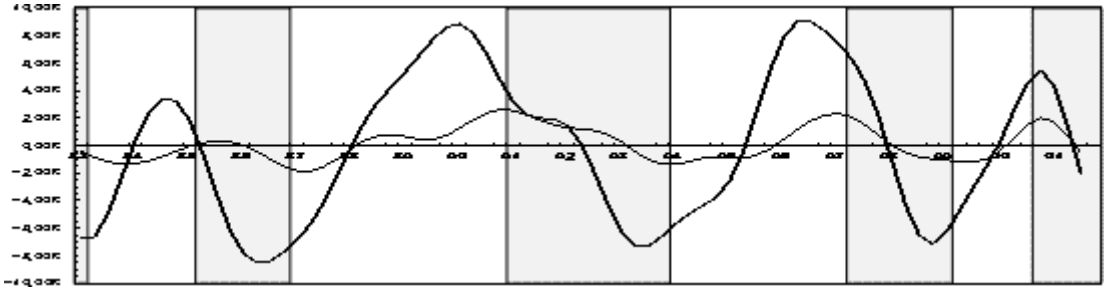
2-5: Public Investment



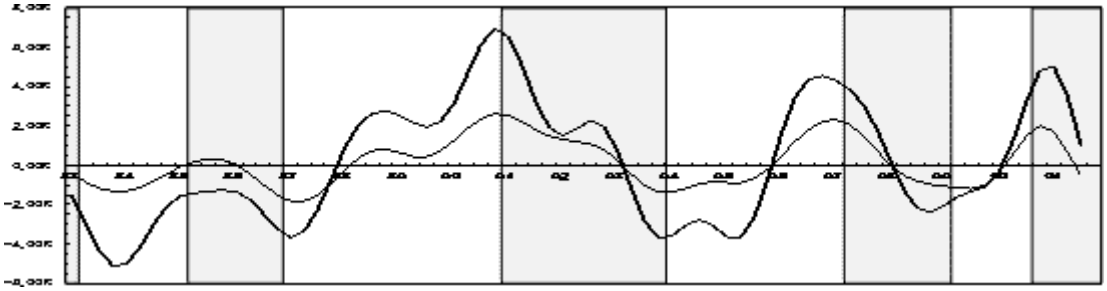
2-6: Exports



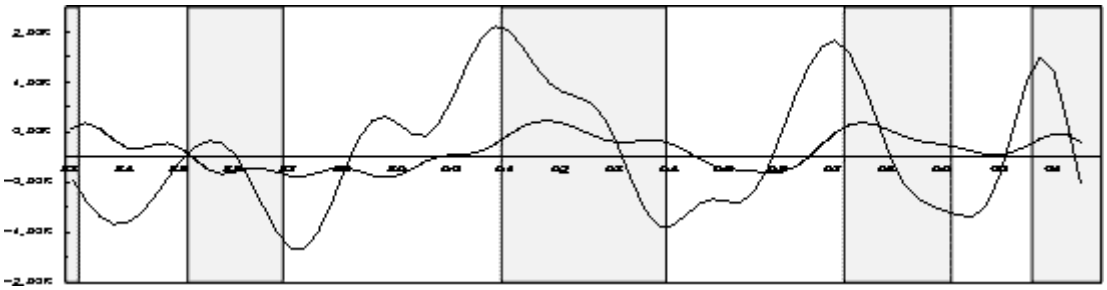
2-7: Imports



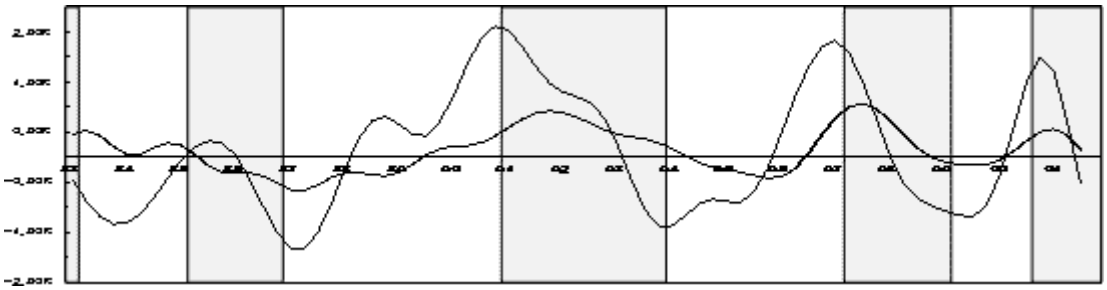
2-8: Gross domestic fixed capital formation



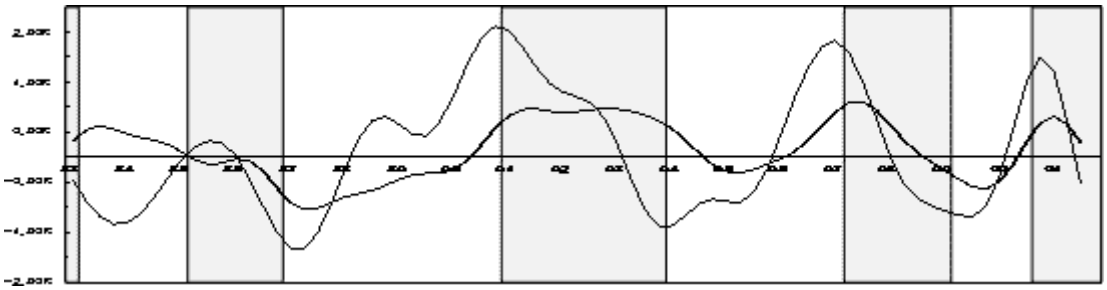
2-9: Labor Force



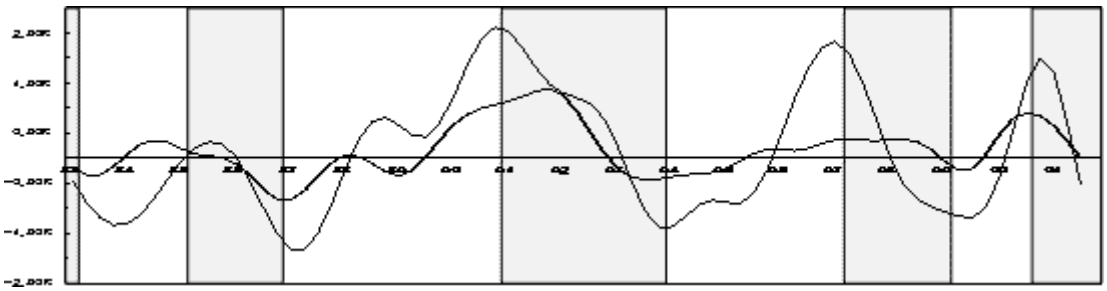
2-10: Total Employed



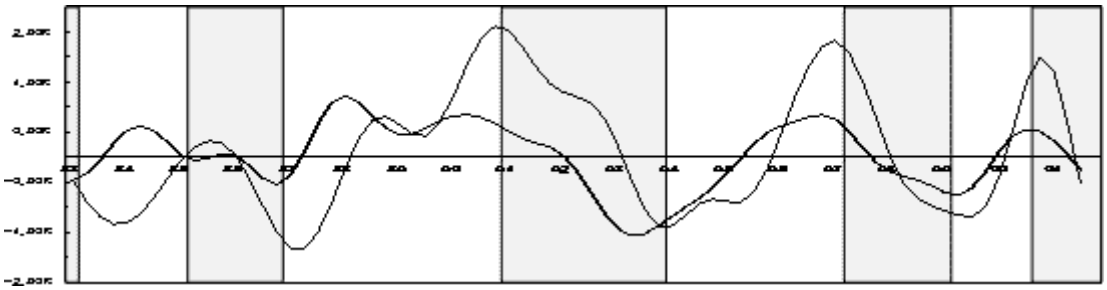
2-11: Employees



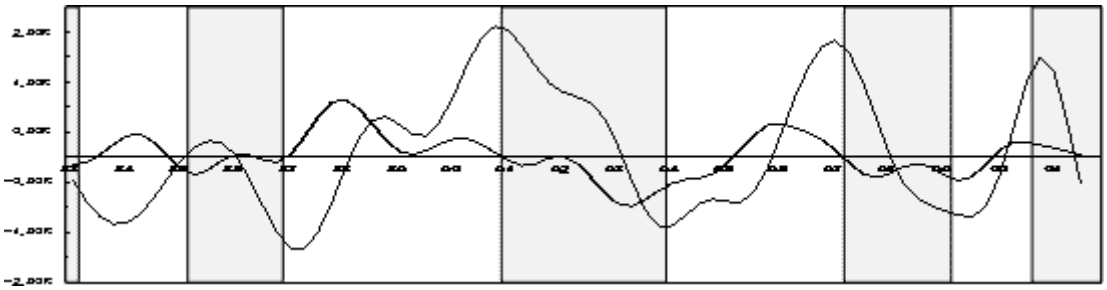
2-12: Total Hours Worked



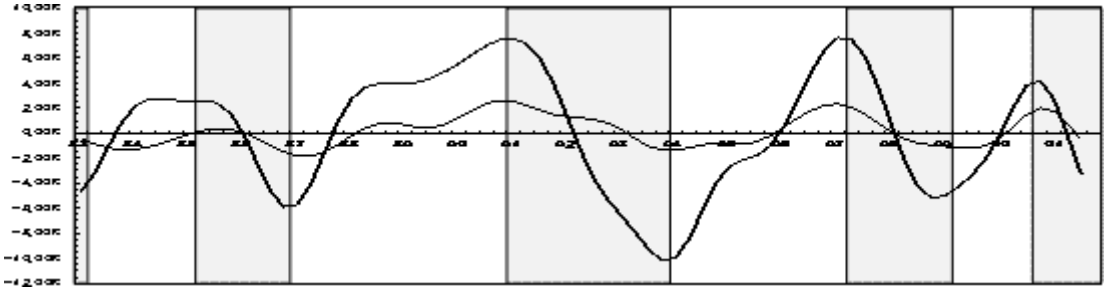
2-13: Average Hours Worked Index (total)



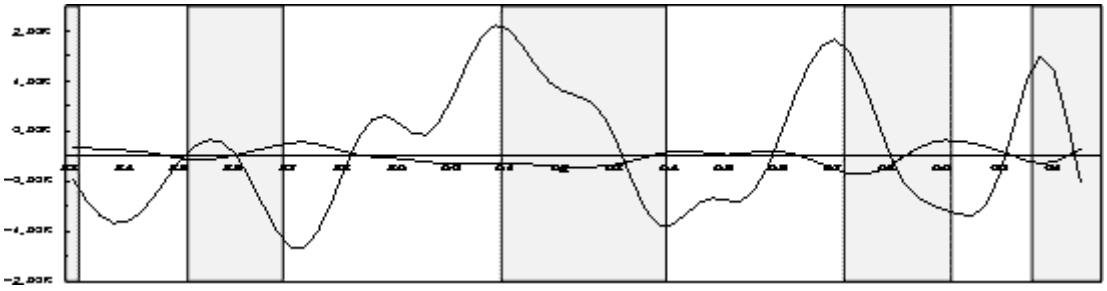
2-14: Average Hours Worked Index (Scheduled)



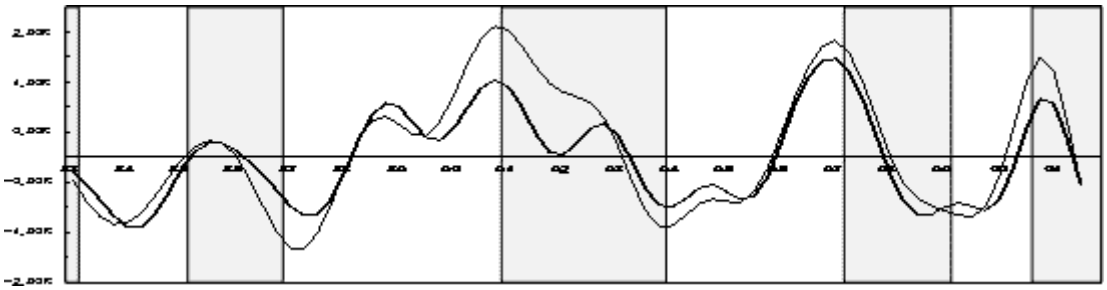
2-15: Average Hours Worked Index (Non-scheduled)



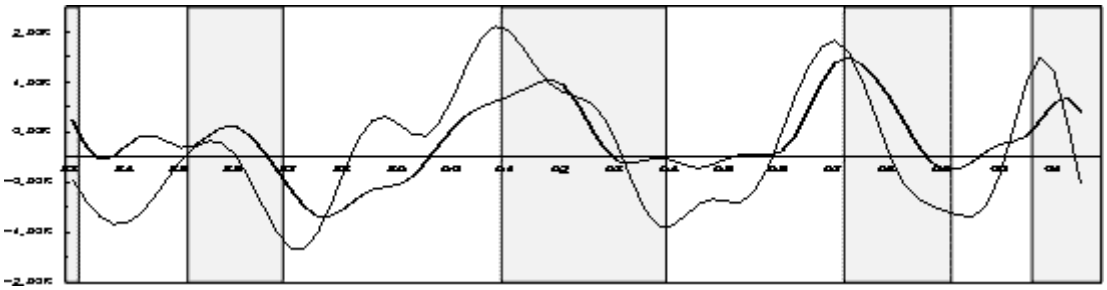
2-16: Ratio of Unemployed in Labor Force



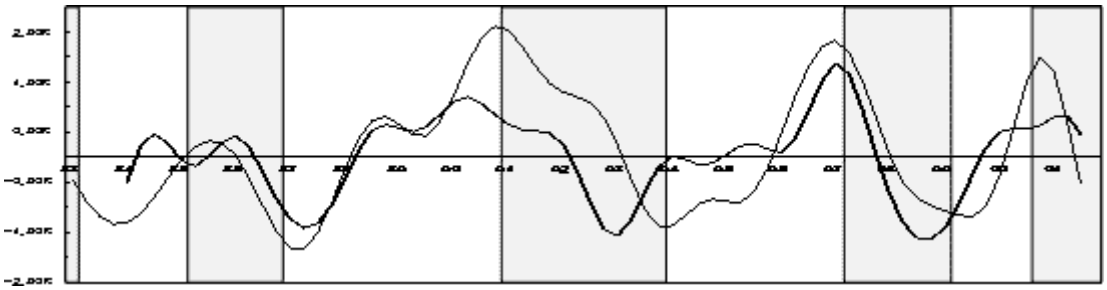
2-17: Labor Productivity



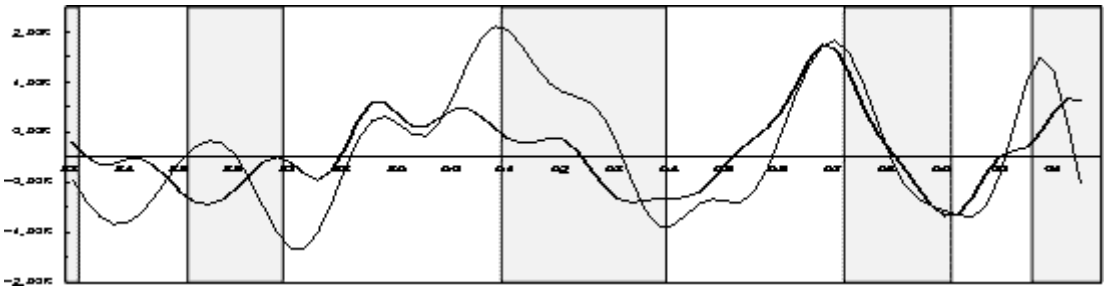
2-18: Wage Index (Total cash earnings, nominal)



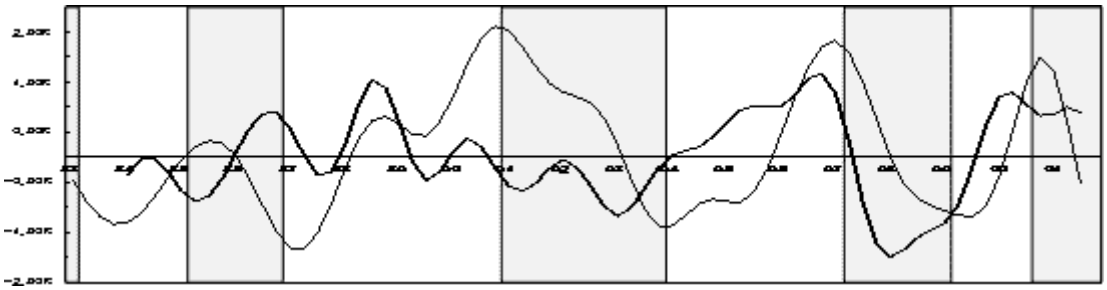
2-19: Wage Index (Total cash earnings, nominal, growth rate)



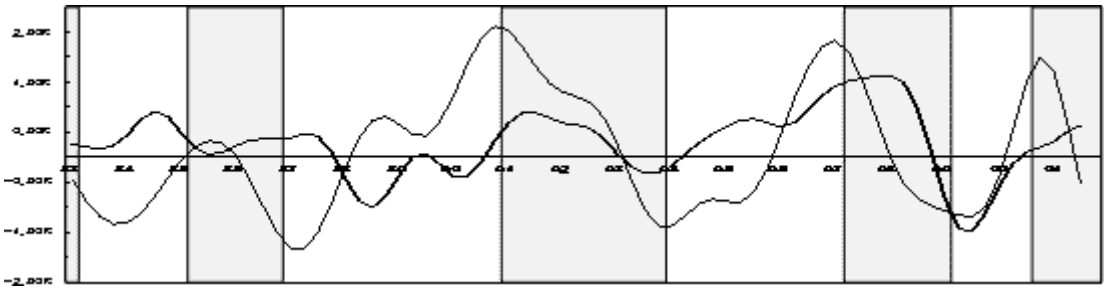
2-20: Wage Index (Total cash earnings, real)



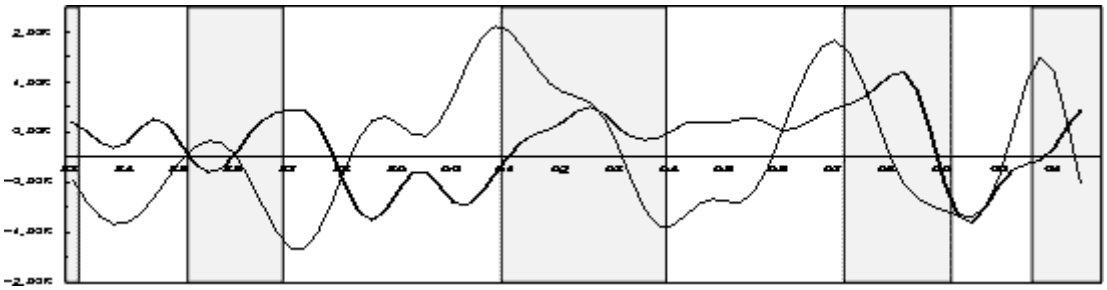
2-21: Wage Index (Total cash earnings, real, growth rate)



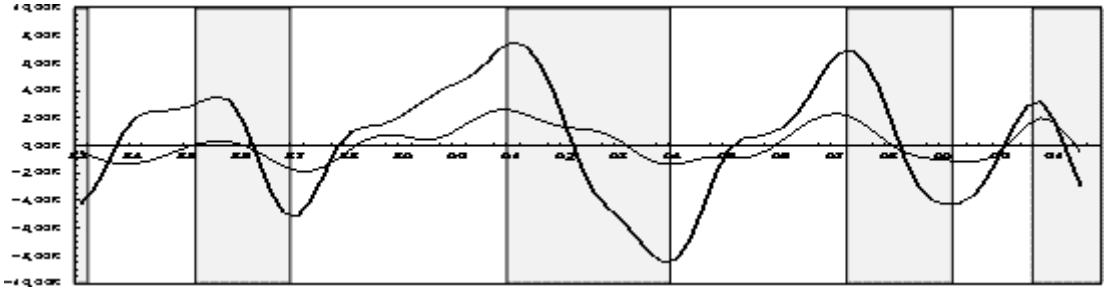
2-22: Wage (Contractual cash earnings)



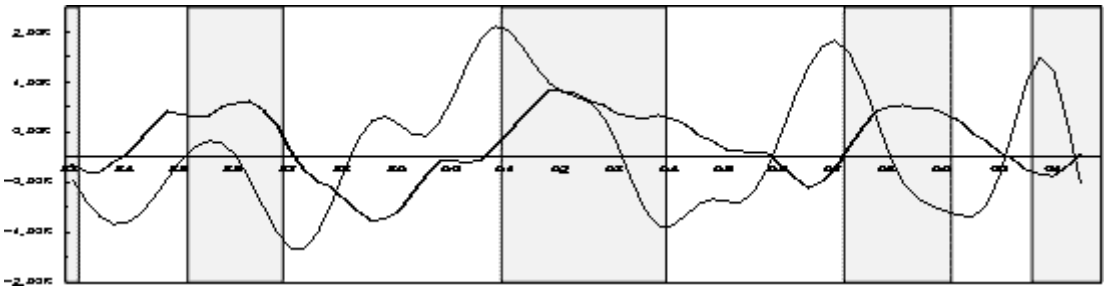
2-23: Wage (Scheduled cash earnings)



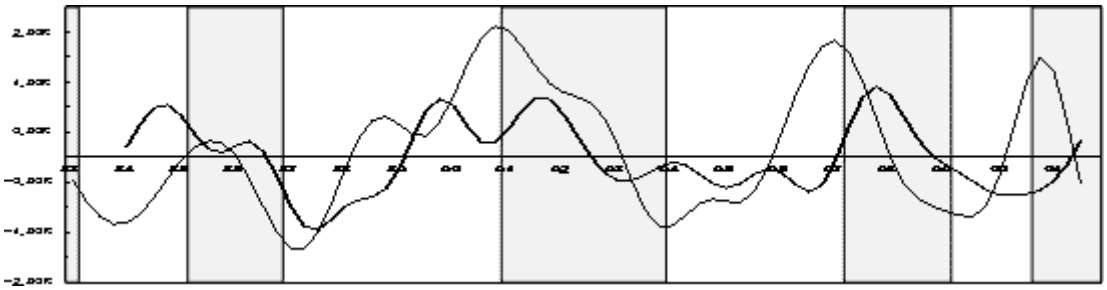
2-24: Wage (Non-scheduled cash earnings)



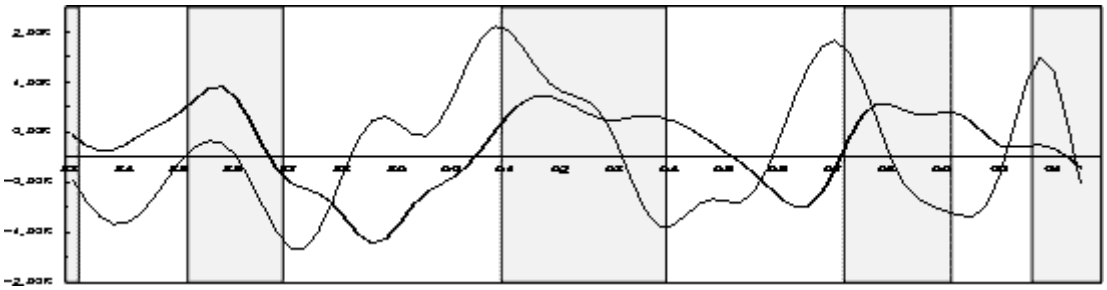
2-25: GDP deflator (level)



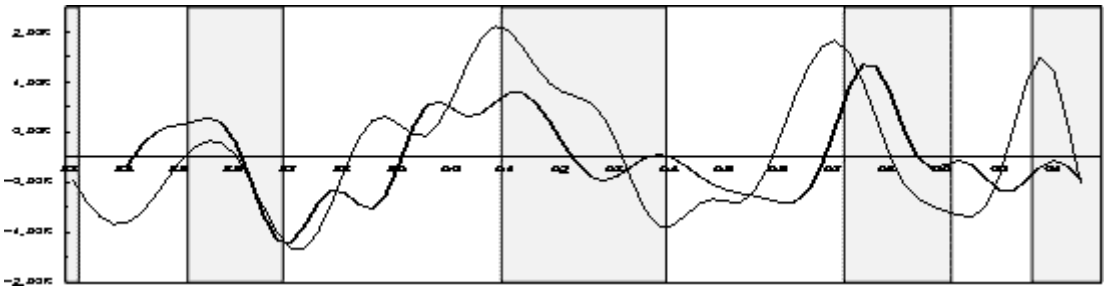
2-26: GDP deflator (growth rate)



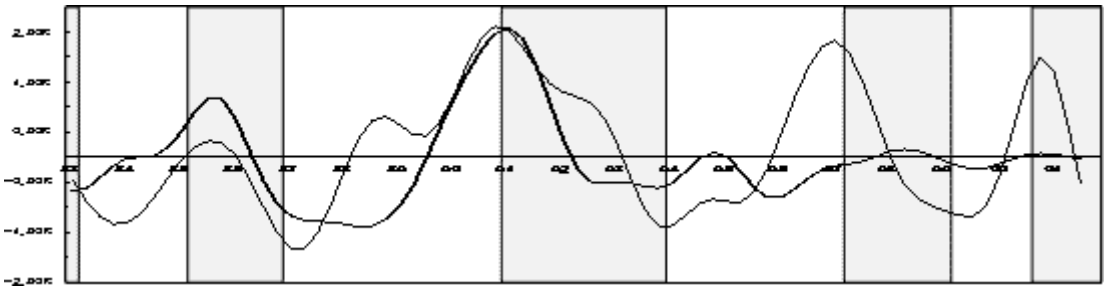
2-27: Consumer Price Index (level)



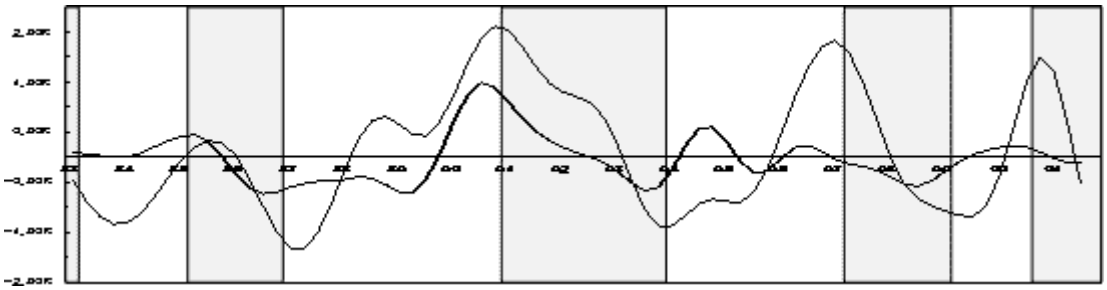
2-28: Consumer Price Index (growth rate)



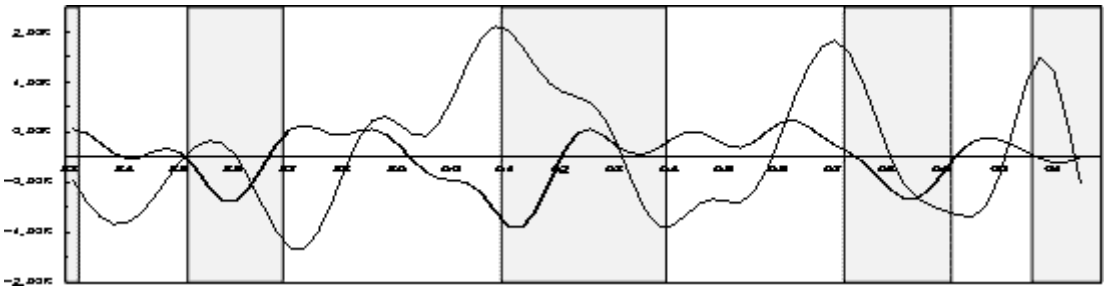
2-29: Call Rates (Collateralized Overnight)



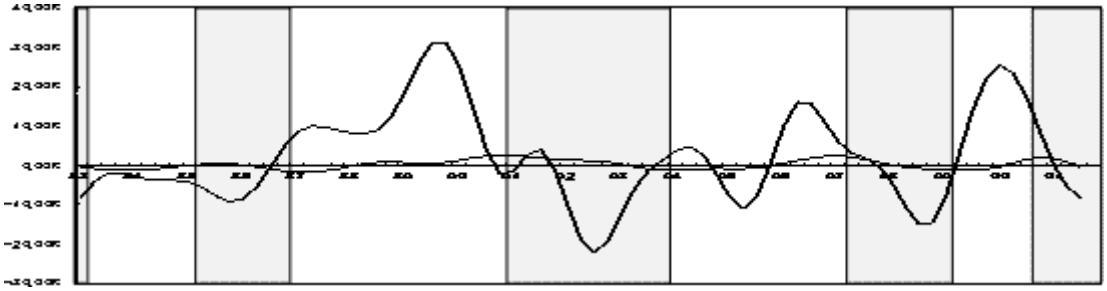
2-30: Newly Issued Government Bonds (10 Years)



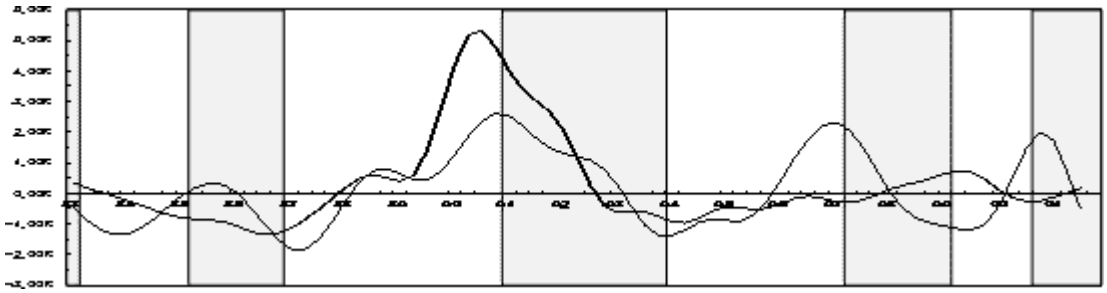
2-31: Interest Rate Spread



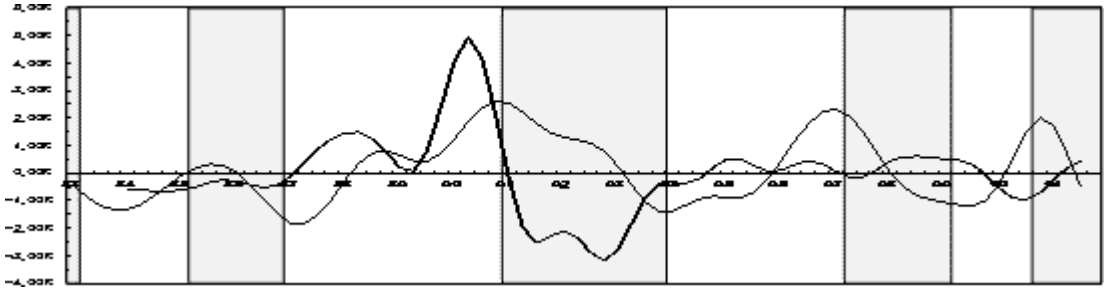
2-32: Stock Price



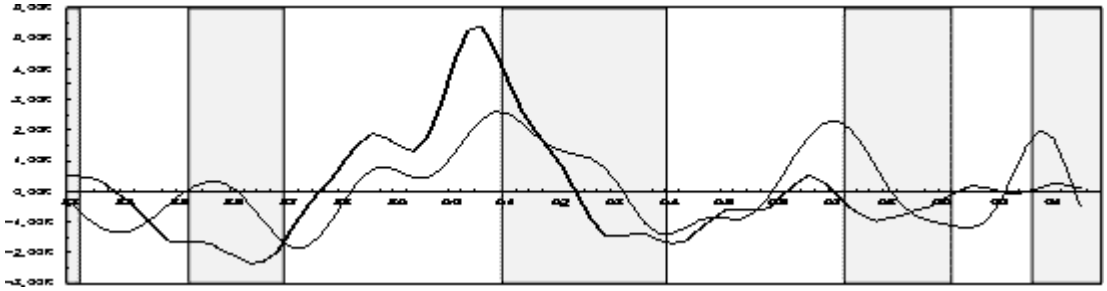
2-33: Money Stock (M2+CD, nominal)



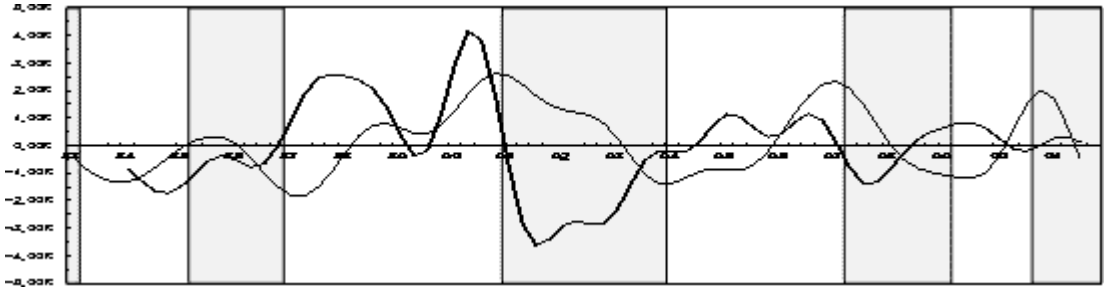
2-34: Money Stock (M2+CD, nominal, growth rate)



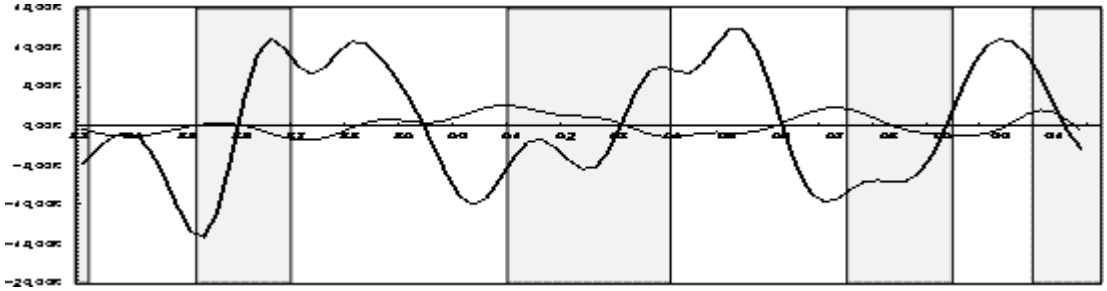
2-35: Money Stock (M2+CD, real)



2-36: Money Stock (M2+CD, real, growth rate)



2-37: Effective Exchange Rates



Note: The vertical scale of the graph may be differ across series.