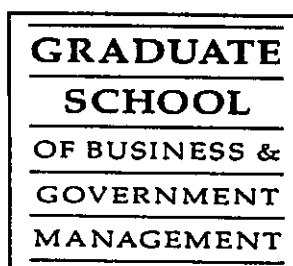


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**Business Cycles in Korea: Is
there any stylised feature?**

**Kunhong Kim
and
Yongyil Choi**



**VICTORIA UNIVERSITY
OF WELLINGTON**



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**BUSINESS CYCLES IN KOREA:
Is there any stylised feature?**

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ABSTRACT

This paper seeks to present the detailed empirical study of contemporary business fluctuations in Korea. It follows the methodology of modern business cycle research in conducting an atheoretical statistical analysis of the cyclical properties of key aggregate time series. Analysis shows that many of the cyclical regularities documented for developed countries also exist in Korean business cycles. Those regularities include the relative volatilities of many expenditure components and the co-movement of real and nominal variables with output. Particularly notable one is the counter-cyclicality of prices. Counter-cyclicality of prices signals the importance of supply side shocks in Korean business fluctuations. It has been revealed in the analysis that the fluctuation in the import price of oil may have been the major source of Korean business cycles. Analysis has also revealed that there are some idiosyncrasies in Korean business cycles. Net exports are significantly pro-cyclical and lead the cycle for most of the period under study.

Keywords: Korean business cycle, Stylised features, Hodrick-Prescott filter, Counter-cyclicality of prices, Import price of oil.

Journal of Economic Literature Classification: C10, E32

I. INTRODUCTION

The goal of this paper is to identify the major stylized facts relating to contemporary business fluctuations in Korea. Lucas (1977), in his seminal paper "Understanding Business Cycles", emphasized the idea of business cycles regularities, a set of common facts in the form of correlation coefficients and standard deviations, as well as the complementary idea that business cycles are all alike. Since his paper, a large body of research has developed trying to measure such regularities empirically. These studies include: Kydland and Prescott (1990) for the U.S.A.; Danthine and Girardin (1989) for Switzerland; Blackburn and Ravn (1992) for the UK; Brandner and Neusser (1992) for Austria and Germany; Correia, Neves and Rebelo (1992) for Portugal; Englund, Persson and Svensson (1990) for Sweden; and Kim, Buckle and Hall (1992) for New Zealand. Almost all of the of the existing studies deal with OECD country data, however. Much less is known about other countries. We investigate whether Korea conforms to the Lucasian view of business cycles as a set of regularities in the movements and co-movements of economic aggregates common to all decentralised economies. We believe that such documentation of simple stylized facts is a necessary and important inductive stage in research on macroeconomic phenomena. It seems absolutely essential to know more precisely what facts one is supposed to explain when developing theoretical models. As far as we know, this paper is the first to identify the main stylized features of Korean business cycles by applying the recent techniques. This inquiry covers the period 1970-91 and uses quarterly data on key economic aggregates. These aggregates include output and its components, employment, nominal variables, variables in foreign trade, and measures of foreign output fluctuations.

The remainder of the paper is organized as follows. Section II contains a description of our procedure for isolating cyclical fluctuations. In Section III, we report business cycle facts based on the whole sample period. In section IV, we investigate the stability of our findings over time. Section V contains some concluding remarks.

II. METHODOLOGY

Lucas defined the business cycle as "movement about trend in gross national product" and the broader concept of business cycle regularities as "co-movement of the deviations from trend in different aggregative time series". If we are to study deviations from trend, how do we define the trend, in practice? Ideally, we would like to base our detrending on firm theoretical grounds. It is indeed possible to construct

theoretical business cycle models that give some guidance on how to detrend. But, unfortunately, these models often involve unbelievable assumptions. For instance, many Real Business Cycle models use a modified neoclassical growth model and express business cycles as fluctuations around a growth path where productivity grows at a constant exogenous rate. Taken literally, this approach would suggest detrending the data by just removing the same log-linear trend from each growing real variable in the model. But the assumption of constant underlying productivity trend is hard to swallow, both from a theoretical and an empirical point of view.

In practice, studies of business cycles typically go for a more flexible approach. Most researchers in the Real Business Cycle tradition have in fact chosen to remove a smooth, but variable trend from the data. Kydland and Prescott (1990) cite as one of their criteria for choosing a trend that “[t]he trend component for real GNP should be approximately the curve that students of business cycles and growth would draw through a time plot of this time series.” The detrending procedure used in our work is the so called Henderson-Whittaker filter, introduced to macroeconomics by Hodrick and Prescott (1980). An important reason for using this filter is to facilitate comparison with other studies. Researchers in the Real Business Cycle tradition have almost universally adopted this method of detrending. The Henderson-Whittaker filter decomposes a given series into a trend component and a cyclical component by finding the solution to an optimization problem, where the trend component’s smoothness is traded off against its ability to track the series well. How the trade-off is resolved depends on the value of the celebrated smoothness coefficient λ . Formally, this filtering requires computation of the trend component, τ_t , of an actual variable, x_t , from the expression:

$$\min_{\{\tau_t\}} \sum_{t=1}^T (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

for an appropriately chosen positive value of λ . The first term is the sum of squared deviations of τ_t from x_t , or degree of fit of τ_t . The second term involves the sum of squares of the trend component’s successive differences and reflects the degree of smoothness of the trend component. For quarterly data most researchers since Hodrick and Prescott have chosen to set $\lambda = 1600$. On comparative grounds, we use this particular value of λ when detrending all the variables in our data set.

Before filtering, we transform most variables to logarithms. The only exceptions are the unemployment rate, which is retained in rate form, and the changes in inventories and net exports, which we express as shares of GDP. All series are seasonally adjusted using the well-known X-11 US Bureau of Census method.

The actual and trend real GDP series are plotted in Figure 1. Figure 2 depicts the resulting cyclical component of the GDP series. In order to get a feeling for the quality of our estimated cyclical component, we superimpose in Figure 2 the peaks and troughs that has been determined by the Economic Planning Board of Korea using several coincident indicators. Peaks are drawn as vertical lines above the horizontal axis, troughs as vertical lines below the axis. With the exception of the trough in 1988, the Henderson-Whittaker filtered series corresponds surprisingly well to the business cycle chronology used at the Economic Planning Board. The cyclical component resulting from applying the Henderson-Whittaker filter has other minor turning points. This seems to be partly due to the fact that the Henderson-Whittaker filter does not extract any of the 'noise' (i.e. very high frequency) component. (See Fig. 2 of Singleton (1988).) Leaving this 'noise' in the series, the resulting filtered series contains several cycles of very short duration.

If business cycle regularities are cyclical comovements between macroeconomic variables, how do we measure these comovements? It has become common practice in the Real Business Cycle literature to measure the comovements by cross-correlation coefficients between different variables and an index of cycle - typically GDP - at different leads and lags. We use such cross-correlation coefficients extensively in the paper. We say that a variable is pro-cyclical (counter-cyclical) if it has predominantly positive (negative) and statistically significant cross-correlation coefficients. Otherwise we call it acyclical. We say that a variable displays cyclical behaviour if the correlation coefficients display a pronounced peak. If such a peak occurs when the variable is lagged (leaded) relative to GDP, we refer to it as a leading (lagging) variable. Amplitudes of fluctuations are measured by the standard deviations of the cyclical component.

III. THE BUSINESS CYCLE FACTS

In this section, we document some relevant facts about the Korean business cycles since 1970. In Tables 1 to 4, we present volatility and correlation measures for the whole 22 year period. In the tables, the second column shows the volatility measure. For each variable, the standard deviation in column 2 can be interpreted as the standard deviation in percentage terms of the trend value of the variables. The following 11 columns show correlation coefficients between the reference series at time t , and each other series at time $t-i$ ($i = -5, -4, \dots, 4, 5$). Numbers in parentheses are standard errors calculated by posing the estimation of various statistics as an "exactly identified" Generalized Method of Moments problem.

Table 1 presents the outcomes of inquiries into the cyclical behaviour of the components of real Gross Domestic Product. These components are total private consumption, gross fixed capital formation, government consumption, net exports and changes in inventories. Total private consumption has been decomposed into consumption of durables, consumption of semidurables, consumption of nondurables and consumption of services. Total fixed capital formation has been decomposed into residential investment, investment on non-residential structures and equipment, and investment on other construction and land development. Inspection of the table reveals that the main features are quite similar to the stylized facts documented for developed OECD countries.

Consumption displays much less variability than output, is strongly procyclical, and moves in phase with the cycle. Consumption of durables is considerably more volatile than consumption of nondurables and services. Relative to output, consumption of durables exhibits approximately three times more cyclical variation whereas consumption of nondurables and services shows much less cyclical variation. The cyclical series for total private consumption and GDP is shown in Figure 3(a). There it is shown that, for most of the period, the two series move closely together and that the consumption series is less volatile.

The percentage cyclical variation in gross fixed investment is more than three times greater than the percentage cyclical variation in output. Residential investment is particularly volatile. All components of fixed investment series are pro-cyclical. Residential investment leads slightly while investment on equipment lags the cycle. We see that the change in business inventories is acyclical. The cyclical series for total fixed investment is shown in Figure 3(b). We can see that, for most of the period, the two series move closely together and that the investment series is a lot more volatile.

Both exports and imports are very volatile. Imports are pro-cyclical, and move in phase with the cycle. Qualitatively, this also is the typical feature observed in OECD country data. Exports are pro-cyclical and lead the cycle for two quarters. The cyclical behaviour of net exports is very different from those of OECD countries. It has been shown by several studies that net exports are counter-cyclical or acyclical in most of OECD countries. In contrast, Table 1 shows that, in Korea, net exports are pro-cyclical and lead the cycle by about three quarters. The cyclical series for net exports is shown in Figure 3(c). Phase shift is evident for most of the sample period.

Finally, we observe that government consumption is about as variable as output, is orthogonal to output, and shows no sign of leading the cycle.

We are led to conclude that cross-country regularities in the cyclical behaviour of output components extend to Korea. The notable difference is the Korean net exports being pro-cyclical and leading the cycle.

Table 2 summarizes findings on the cyclical properties of manufacturing and labour market variables. Employment is much less variable than output and is positively correlated with it. Labour productivity measured by the output per employee is almost as variable as output and is very strongly pro-cyclical. Unemployment rate is counter-cyclical. The manufacturing sector has traditionally been regarded as very cyclical. According to Table 2 this notion contains some truth, since manufacturing production is about 1.5 times as volatile as GDP. Cycles for manufacturing production are highly synchronized with cycles for GDP. Real wage in manufacturing sector shows somewhat more variability than GDP and is pro-cyclical. Both labour productivity and real wages move contemporaneously with the cycle. All of these findings are comparable with those for the U.S.A. and other OECD countries. Employment is positively correlated with real wages. Danthine and Donaldson (1993) find that the correlation between real wages and employment and between productivity and employment vary substantially across countries.

The behaviour of nominal variables has traditionally been the subject of much attention in business cycle research. The statistical properties of the cyclical components of various nominal aggregates are summarized in Table 3. Nominal aggregates investigated are prices, money supplies and velocities. Price series include GDP deflator, consumer price index and wholesale price index. Monetary base, M1 and M2 were considered for money supply series.

Monetary base, M1 and M2 are all pro-cyclical. There is no evidence that the monetary base leads the cycle. Both M1 and M2 lead the cycle by a quarter.

Of great interest is the observed strong counter-cyclicity of prices. This is an observation that runs counter to a widely held belief. It has been confirmed in several studies, being one of the most robust empirical regularities in industrialized countries. It is interesting to note that it also holds in industrializing countries like Korea. Counter-cyclicity of GDP deflator is clearly displayed in Figure 3(d). Counter-cyclicity of price levels implies that business fluctuations in Korea might have been dominated by supply side shocks.

Earlier, we stressed the Korean net exports as pro-cyclical and leading the cycle as a notable difference from the documented stylized features of business cycles in industrialized countries. In light of the general recognition that remarkable Korean

economic growth during the period of our investigation has been heavily dependent on foreign trade, it is quite interesting to see whether there is any notable feature in the behaviour of foreign trade variables along business cycle frequencies. Table 4 presents a few additional facts related to an open economy aspect. The terms of trade is defined as the ratio of the unit value of imports to the unit value of exports. Relative price of exports (imports) is the ratio of the unit value of exports (imports) to the GDP deflator. U.S. GDP and Japanese GNP series are included to gain an impression on cross country linkages between national business cycles. U.S.A. and Japan have been the major trading partners of Korea.

In Table 4, Korean output is seen to be positively correlated with U.S. output. This gives some indication that business cycles are correlated between these two countries. Correlation between Korean output and Japanese output is very low. Comparing the standard deviations of GDP (GNP) in Korea, the U.S.A. and Japan, it is apparent that the amplitude of fluctuations are much more pronounced in Korea.

Table 4 reveals that terms of trade, relative price of exports and relative price of imports are all very volatile and lead the cycle. Terms of trade is counter-cyclical and leads the cycle by one quarter. Relative price of imports is much more volatile than the relative price of exports. It is counter-cyclical and leads the cycle by two quarters. In light of the fact that fossil fuel is the second largest import item for Korea, it is very revealing to note that the relative price of imported oil, which is the ratio of nominal price of imported oil to the GDP deflator, is significantly counter-cyclical and leads the cycle for about two quarters. Table also shows that the relative price of imported oil is significantly positively correlated with the GDP deflator, the consumer price index and the wholesale price index. The most striking feature revealed in Table 3 was the strong counter-cyclicity of price levels. The behaviour of oil price documented in Table 4 is quite revealing in that it might provide the explanation for the counter-cyclicity of price levels in Korean business cycles.

One of the central relationships in international economics is the dynamic relationship between the terms of trade and net export. Known as the J-curve, this relationship has been subject to numerous empirical investigations. The cross-correlations between the terms of trade and net exports at various leads and lags appear in Table 4. The result displays the J-curve.

III. STABILITY OVER TIME

The business cycle facts reported in the previous section are for the whole 22 year period 1970-1991. For the statistical properties of cyclical fluctuations to constitute stylized facts, they must remain broadly invariant to the passage of time. It

is therefore legitimate to ask whether the facts are stable over time. In order to check whether the business cycle patterns in the economy may have changed over the period, we show figures with moving statistics: In Figures 4 - 7, we use a window of ± 10 quarters and compute standard deviations and correlation coefficients recursively over time. When reading those figures, note that it is the centre of the window that is displayed on the horizontal axis. The first observation, which is dated 1972:3, is thus the statistic for the subperiod 1970:1 to 1975:1.

The moving *standard deviations* presented for output, private consumption and total fixed investment in Figure 4 are broadly similar. Volatility of the real GDP, private consumption and total fixed investment is above average between 1976:1 and 1981:4, and thereafter below average. Moving standard deviations for exports, imports and net exports are also broadly similar to each other. But they are quite different from those for output, private consumption and total fixed investment. This implies that the relative standard deviations between these two groups of variables have changed a lot. Moving standard deviations for government purchases is distinctively different from those of other real variables. It is worthwhile to note that the moving standard deviations of all the open economy variables plotted in Figure 4, which include the terms of trade and the relative price of exports and imports in addition to exports, imports and net export share, are broadly similar. There is some evidence that the Korean business cycle has become less volatile since early 1980's. Most variables exhibit more stability after the early 80's than before the early 80's.

For the moving contemporary *cross correlations*, the major matter of interest is whether the variables remain consistently pro- or counter-cyclical, or not. Figure 5 shows moving contemporaneous cross correlations between various real GDP expenditure components and real GDP.

- Private consumption and total fixed investment were consistently pro-cyclical until (centred) early 80's but pro-cyclicality has fallen dramatically since then and correlations are even negative for some periods.
- Except for short periods, exports and imports were pro-cyclical.
- Pro-cyclicality of Korean net exports emphasized earlier is quite consistent. Pro-cyclicality is a lot stronger since mid 80's.
- Real government consumption shifts no fewer than four times between pro- and counter-cyclicity. This is an expected result. Most of the existing literature on stylized features of business cycles in OECD countries point out that there is no

evidence of close correlation between government expenditure and output variation.

Figure 6 shows moving contemporaneous cross correlations between real GDP and various variables relating to an open economy.

- Korean business cycle has been more strongly correlated with the output of the U.S.A. than that of Japan. Cross country correlations were quite large during the mid 70's. In light of the big international events like oil price shocks that happened during the 70's, this is not surprising.
- Earlier we noted that various open economy variables leading the cycle as an interesting feature of Korean business cycles. Figure 6 shows that, for significant proportion of the sample period, exports, net export share, the terms of trade, the relative price of exports, the relative price of imports and the relative price of oil import indeed lead the cycle.
- The terms of trade, the relative price of imports and the relative price of oil import were counter-cyclical for most of the sample period. Counter-cyclicity was particularly strong during the period from mid 70's to early 80's.

Figure 6 shows moving contemporaneous cross correlations between various nominal and labour market variables and real GDP.

- Fluctuations in the three price variables exhibit consistent counter-cyclicity.
- Except for a short period, money stocks were pro-cyclical.
- There is no evidence that money stock has been leading the cycle consistently.
- Manufacturing output and labour productivity has been highly pro-cyclical consistently.
- Employment has been pro-cyclical for most of the period.
- Real wages were pro-cyclical until early 80s but became counter-cyclical since then.

What is very surprising and puzzling in the above analysis is the fact that the pro-cyclicity of the private consumption and the total fixed investment dropped dramatically since early 80's. What we have to consider is the fact that 1986-1989 was a rather unusual period in recent Korean economic history. Figure 8 plots Korean net exports as a share of GDP over the period of our investigation. As Figure 8 shows, Korean net exports had been consistently negative until 1985. Net export position suddenly became surplus in 1986 and remained surplus until 1989. Since then it moved into large deficit again. During this 1986-1989 period variables moved quite differently. For example, as Figure 3 (a) and (b) show, output was above trend

during this period but consumption and investment were below trend. Also, positive correlation between net export and output was unusually high during this period. (See Figure 3 (c).) Figure 3 (a) and (b) also show that close positive correlation between output and private consumption and between output and total fixed investment have been restored after 1989. If we exclude this 1986-1989 period, many of the cross-correlations would look much more stable.

IV. CONCLUDING REMARKS

In this paper we have sought to present results from a detailed empirical study of contemporary business fluctuations in Korea. We have followed the methodology of modern business cycle research in conducting an atheoretical statistical analysis of the cyclical properties of key aggregate time series.

The analysis has shown that many of the cyclical regularities documented for developed countries exist in Korean business cycles also. Those regularities include the relative volatilities of many expenditure components and the comovement of real and nominal variables with output. Particularly notable one is the counter-cyclicality of prices. Counter-cyclicality of prices signals the importance of supply side shocks in Korean business fluctuations. It has been revealed in the analysis that the fluctuation in the import price of oil may have been the major source of Korean business cycles. More rigorous econometric investigation of the relative importance of various shocks in generating Korean business fluctuations is one of our research agenda (Kim and Choi (1994)).

The analysis has also revealed that there are some notable idiosyncrasies in Korean business cycles. Net exports are significantly pro-cyclical. There is strong evidence that open economy related variables are leading the cycle for most of the period under study. When better documented, these idiosyncrasies will certainly form the basis for the argument on the relevance of various business cycle theories.

Stability analysis showed that usual comovements didn't hold during 1986-1989 period. It would be very worthwhile to investigate the main cause of this break down.

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Table 1
Cyclical Properties of Expenditure Components
1970:1 - 1991:4

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Real Gross Domestic Product	2.80 (.27)	0.03 (.12)	0.19 (.09)	0.22 (.09)	0.46 (.08)	0.58 (.09)	1.00 -	0.58 (.11)	0.46 (.10)	0.22 (.11)	0.19 (.10)	0.03 (.12)
Components of Expenditure on Real GNP												
Private Consumption	1.69 (.17)	-0.20 (.13)	-0.17 (.16)	0.03 (.10)	0.25 (.11)	0.43 (.11)	0.70 (.06)	0.60 (.11)	0.51 (.12)	0.35 (.14)	0.28 (.11)	0.15 (.12)
Durables	8.44 (.90)	0.03 (.10)	0.15 (.12)	0.40 (.11)	0.52 (.13)	0.69 (.12)	0.71 (.06)	0.58 (.10)	0.47 (.10)	0.29 (.12)	0.10 (.15)	-0.07 (.17)
Semidurables	3.55 (.39)	-0.02 (.10)	0.08 (.12)	0.25 (.11)	0.38 (.12)	0.50 (.12)	0.60 (.07)	0.59 (.08)	0.52 (.09)	0.38 (.12)	0.19 (.12)	0.14 (.12)
Nondurables	1.74 (.21)	-0.27 (.14)	-0.28 (.18)	-0.05 (.10)	0.16 (.10)	0.31 (.09)	0.58 (.07)	0.48 (.11)	0.45 (.13)	0.33 (.15)	0.29 (.11)	0.21 (.12)
Services	1.93 (.15)	-0.03 (.13)	0.03 (.11)	0.09 (.11)	0.24 (.14)	0.31 (.11)	0.48 (.08)	0.34 (.13)	0.17 (.11)	-0.01 (.11)	0.01 (.13)	-0.17 (.13)
Fixed Capital Formation	8.95 (.77)	-0.10 (.12)	0.05 (.11)	0.23 (.12)	0.45 (.11)	0.55 (.09)	0.62 (.07)	0.51 (.10)	0.47 (.12)	0.40 (.12)	0.23 (.13)	0.13 (.10)
Nonresidential												
Structure	14.13 (1.34)	-0.18 (.11)	-0.12 (.16)	0.13 (.14)	0.31 (.10)	0.40 (.07)	0.45 (.08)	0.37 (.08)	0.48 (.13)	0.37 (.13)	0.18 (.14)	0.06 (.11)
Equipment	11.42 (1.31)	-0.04 (.12)	0.08 (.10)	0.21 (.10)	0.40 (.12)	0.50 (.11)	0.51 (.08)	0.54 (.11)	0.48 (.10)	0.42 (.11)	0.25 (.11)	0.21 (.10)
Residential	20.59 (2.34)	-0.09 (.11)	-0.10 (.11)	0.03 (.13)	0.20 (.13)	0.39 (.09)	0.40 (.09)	0.25 (.08)	0.18 (.11)	0.19 (.10)	0.13 (.09)	0.02 (.10)
Other Const. and Land Dev.	11.49 (1.22)	0.02 (.11)	0.22 (.12)	0.22 (.11)	0.20 (.11)	0.05 (.11)	0.14 (.10)	0.02 (.11)	0.14 (.12)	0.05 (.10)	0.07 (.10)	-0.06 (.10)
Government Consumption	2.90 (.23)	-0.00 (.10)	0.08 (.13)	0.11 (.14)	0.00 (.11)	-0.07 (.11)	-0.01 (.10)	-0.08 (.13)	0.07 (.12)	0.18 (.11)	0.13 (.10)	0.20 (.12)
Exports	7.85 (.65)	0.12 (.09)	0.25 (.10)	0.31 (.10)	0.37 (.09)	0.35 (.09)	0.23 (.10)	0.11 (.09)	-0.01 (.09)	-0.14 (.10)	-0.25 (.09)	-0.30 (.09)
Imports	7.68 (.78)	-0.15 (.10)	-0.02 (.09)	0.16 (.09)	0.36 (.12)	0.52 (.11)	0.58 (.06)	0.49 (.10)	0.41 (.09)	0.25 (.10)	0.16 (.10)	0.04 (.11)
Share of Expenditure on Real GNP												
Changes in Business Inventories (Mean 0.92%)	4.17 (.90)	-0.03 (.11)	-0.13 (.09)	-0.06 (.09)	-0.01 (.09)	0.08 (.09)	-0.05 (.17)	0.09 (.09)	0.07 (.07)	0.11 (.08)	-0.02 (.09)	0.07 (.07)
Net Exports (Mean -2.50%)	3.19 (.30)	0.38 (.10)	0.43 (.10)	0.47 (.11)	0.40 (.08)	0.28 (.10)	0.14 (.11)	0.06 (.10)	-0.05 (.09)	-0.17 (.10)	-0.31 (.09)	-0.33 (.09)

Source of data: Bank of Korea

Table 2
Cyclical Properties of Manufacturing and Labour Market Variables
1970:1 - 1991:4

Variable x	Volatility:	Cross Correlation of Real GDP with										
	% Std. Dev.	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Employment	1.26 (.15)	0.06 (.09)	0.18 (.09)	0.16 (.10)	0.20 (.08)	0.33 (.10)	0.43 (.10)	0.32 (.12)	0.20 (.09)	0.24 (.10)	0.11 (.08)	0.03 (.11)
Labour Productivity	2.51 (.24)	0.01 (.13)	0.12 (.09)	0.20 (.07)	0.40 (.08)	0.48 (.08)	0.89 (.03)	0.49 (.10)	0.40 (.10)	0.15 (.10)	0.15 (.10)	0.02 (.11)
Unemployment Rate	0.48 (.08)	0.02 (.09)	-0.15 (.09)	-0.25 (.10)	-0.37 (.09)	-0.54 (.09)	-0.66 (.07)	-0.54 (.12)	-0.34 (.08)	-0.25 (.08)	-0.08 (.09)	0.08 (.18)
Manufacturing Production	4.62 (.34)	0.06 (.09)	0.23 (.09)	0.41 (.10)	0.58 (.11)	0.74 (.11)	0.76 (.05)	0.58 (.10)	0.46 (.09)	0.27 (.10)	0.09 (.10)	-0.06 (.13)
Real Wage	3.67 (.27)	0.00 (.10)	0.04 (.10)	0.11 (.10)	0.22 (.11)	0.32 (.11)	0.42 (.11)	0.34 (.10)	0.38 (.09)	0.36 (.10)	0.34 (.10)	0.31 (.11)

Variable x	Cross Correlation of Real Wage with										
	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Employment	0.26 (.09)	0.25 (.09)	0.32 (.10)	0.28 (.08)	0.35 (.08)	0.29 (.09)	0.19 (.11)	0.03 (.10)	0.05 (.11)	-0.02 (.10)	-0.11 (.09)

Source of data: Production and Wage Rate in Manufacturing Sector
All Others

International Financial Statistics
Bank of Korea

Table 3
Cyclical Properties of Nominal and Financial Variables
1970:1 - 1991:4

Variable x	Volatility:	Cross Correlation of Real GDP with										
	% Std. Dev.	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Price Level												
GDP Deflator	3.21 (.24)	-0.17 (.10)	-0.28 (.09)	-0.27 (.10)	-0.39 (.08)	-0.42 (.10)	-0.56 (.06)	-0.41 (.09)	-0.31 (.11)	-0.18 (.11)	-0.16 (.12)	-0.04 (.12)
Consumer Price Index	4.23 (.33)	-0.13 (.11)	-0.24 (.11)	-0.37 (.10)	-0.49 (.09)	-0.57 (.09)	-0.58 (.06)	-0.53 (.10)	-0.49 (.12)	-0.39 (.13)	-0.24 (.13)	-0.08 (.12)
Wholesale Price Index	6.09 (.44)	-0.14 (.10)	-0.28 (.11)	-0.43 (.10)	-0.57 (.10)	-0.62 (.10)	-0.61 (.07)	-0.54 (.10)	-0.43 (.12)	-0.29 (.13)	-0.12 (.13)	-0.01 (.13)
Money Supply												
Monetary Base	9.37 (.69)	-0.30 (.10)	-0.12 (.13)	0.16 (.11)	0.33 (.12)	0.45 (.10)	0.52 (.08)	0.46 (.10)	0.43 (.11)	0.39 (.13)	0.31 (.12)	0.24 (.12)
M1	5.47 (.37)	-0.00 (.10)	0.12 (.10)	0.23 (.09)	0.41 (.09)	0.52 (.09)	0.47 (.06)	0.30 (.09)	0.17 (.09)	0.10 (.11)	0.04 (.14)	-0.03 (.14)
M2	2.97 (.19)	-0.10 (.10)	0.04 (.10)	0.16 (.10)	0.24 (.09)	0.36 (.09)	0.31 (.09)	0.19 (.10)	0.03 (.10)	-0.13 (.09)	-0.19 (.10)	-0.22 (.11)
Velocity												
Monetary Base	8.82 (.63)	0.26 (.10)	0.09 (.13)	-0.20 (.10)	-0.35 (.11)	-0.45 (.10)	-0.44 (.08)	-0.46 (.09)	-0.42 (.11)	-0.40 (.13)	-0.33 (.12)	-0.26 (.12)
M1	5.87 (.49)	-0.08 (.10)	-0.18 (.10)	-0.26 (.09)	-0.38 (.09)	-0.44 (.09)	-0.27 (.08)	-0.23 (.09)	-0.11 (.09)	-0.09 (.12)	-0.04 (.15)	0.02 (.14)
M2	3.58 (.37)	-0.05 (.10)	-0.14 (.11)	-0.20 (.09)	-0.19 (.08)	-0.23 (.09)	0.02 (.07)	-0.07 (.10)	0.06 (.10)	0.11 (.11)	0.16 (.10)	0.17 (.10)

Source of data: Bank of Korea

Table 4
Cyclical Properties of Open Economy Variables
1970:1 - 1991:4

Variable x	Volatility:	Cross Correlation of Real GDP with										
	% Std. Dev.	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Output U.S.	1.83 (.13)	-0.18 (.09)	-0.07 (.09)	0.13 (.10)	0.29 (.10)	0.40 (.09)	0.37 (.09)	0.39 (.09)	0.37 (.10)	0.38 (.11)	0.32 (.12)	0.29 (.12)
Output Japan	1.32 (.16)	-0.18 (.09)	-0.09 (.11)	-0.03 (.11)	0.05 (.09)	0.08 (.08)	0.03 (.08)	0.02 (.10)	0.01 (.10)	0.01 (.11)	0.05 (.12)	0.13 (.10)
Terms of Trade	5.89 (.55)	-0.22 (.10)	-0.32 (.10)	-0.41 (.10)	-0.51 (.09)	-0.55 (.10)	-0.50 (.08)	-0.41 (.10)	-0.29 (.10)	-0.13 (.10)	-0.04 (.11)	0.05 (.11)
Relative Price of Exports	4.37 (.44)	-0.21 (.11)	-0.25 (.12)	-0.41 (.11)	-0.33 (.11)	-0.21 (.11)	-0.05 (.09)	-0.11 (.12)	-0.07 (.12)	0.01 (.11)	0.12 (.10)	0.05 (.09)
Relative Price of Imports	8.46 (.83)	-0.26 (.11)	-0.35 (.11)	-0.50 (.11)	-0.52 (.10)	-0.49 (.10)	-0.37 (.09)	-0.34 (.12)	-0.24 (.12)	-0.09 (.11)	0.04 (.11)	0.06 (.10)
Relative Price of Imported Oil	23.41 (1.76)	-0.15 (.10)	-0.33 (.09)	-0.45 (.09)	-0.47 (.09)	-0.45 (.09)	-0.42 (.09)	-0.35 (.10)	-0.21 (.11)	-0.08 (.11)	0.03 (.11)	0.02 (.10)

Variable x	Cross Correlation of Relative Price of Imported Oil with										
	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
GDP Deflator	-0.03 (.12)	0.01 (.11)	0.09 (.12)	0.25 (.11)	0.38 (.11)	0.49 (.07)	0.55 (.08)	0.56 (.08)	0.52 (.09)	0.37 (.08)	0.18 (.09)
Consumer Price Index	-0.11 (.10)	-0.07 (.11)	0.03 (.12)	0.17 (.12)	0.34 (.11)	0.52 (.08)	0.62 (.08)	0.63 (.08)	0.59 (.08)	0.49 (.08)	0.33 (.09)
Wholesale Price Index	-0.03 (.11)	0.07 (.12)	0.21 (.13)	0.38 (.12)	0.57 (.10)	0.73 (.05)	0.77 (.07)	0.67 (.08)	0.54 (.09)	0.37 (.10)	0.18 (.10)

Variable x	Cross Correlation of Terms of Trade with										
	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Net Exports Share	-0.29 (.11)	-0.40 (.11)	-0.51 (.11)	-0.57 (.11)	-0.58 (.11)	-0.54 (.11)	-0.37 (.12)	-0.19 (.11)	-0.01 (.10)	0.22 (.10)	0.36 (.10)

Source of data: Output Japan (GNP of Japan)	International Financial Statistics
Price of Imported Oil	Korea Development Institute
All others	Bank of Korea

FIGURE 1: REAL GDP: ACTUAL AND TREND
1970(1) - 1991(4)

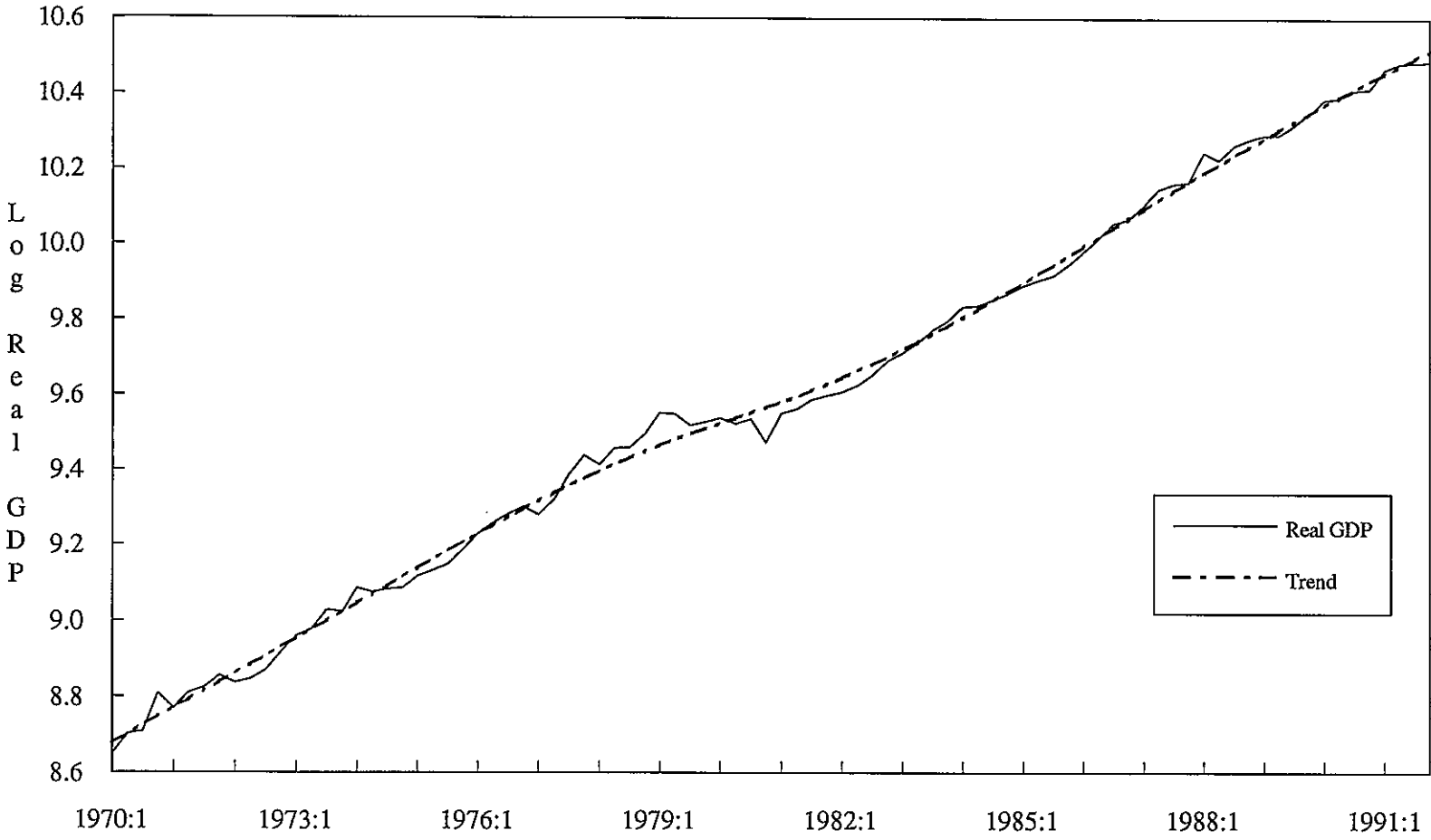


FIGURE 2: REAL GDP: DEVIATIONS FROM TREND
1970(1) - 1991(4)

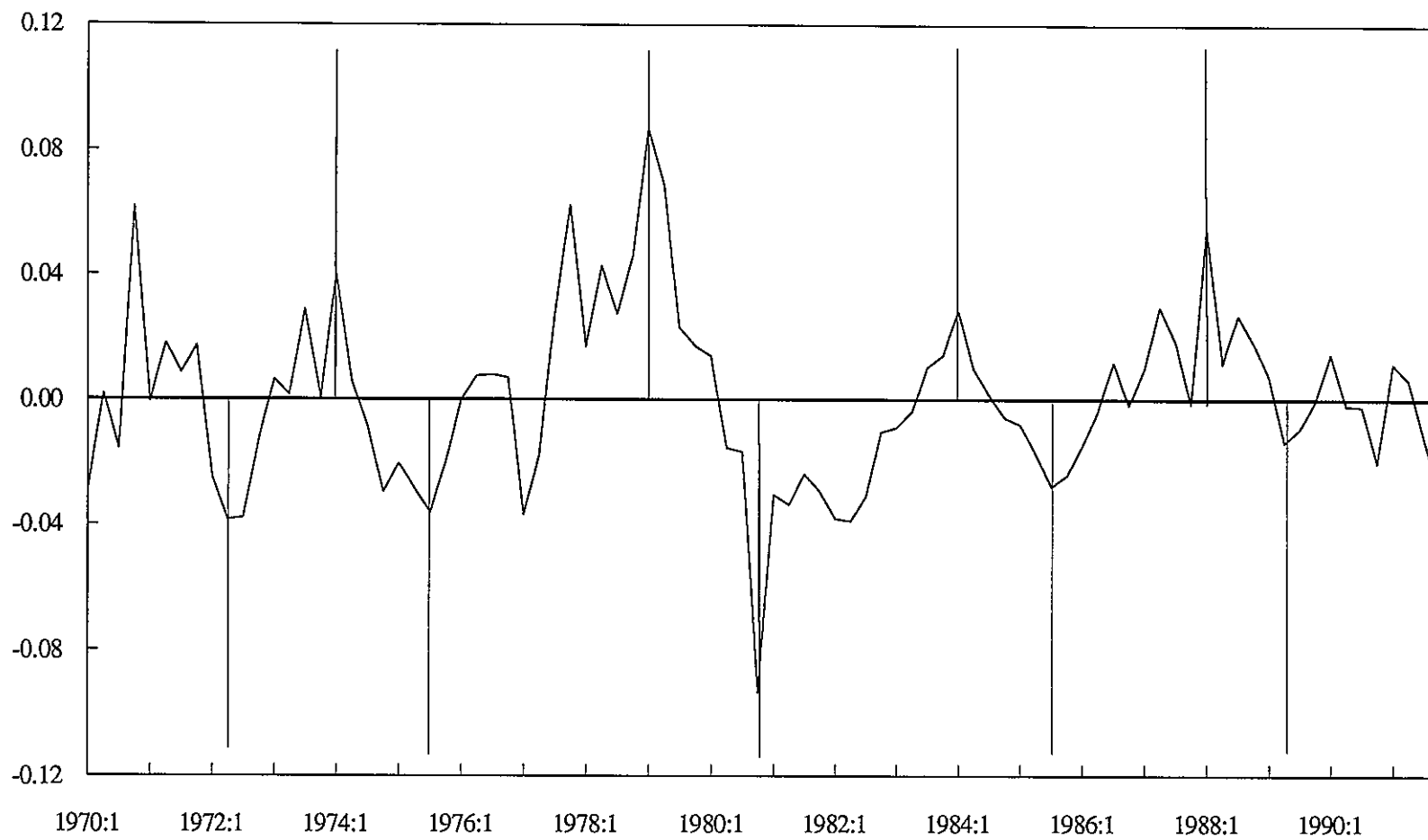
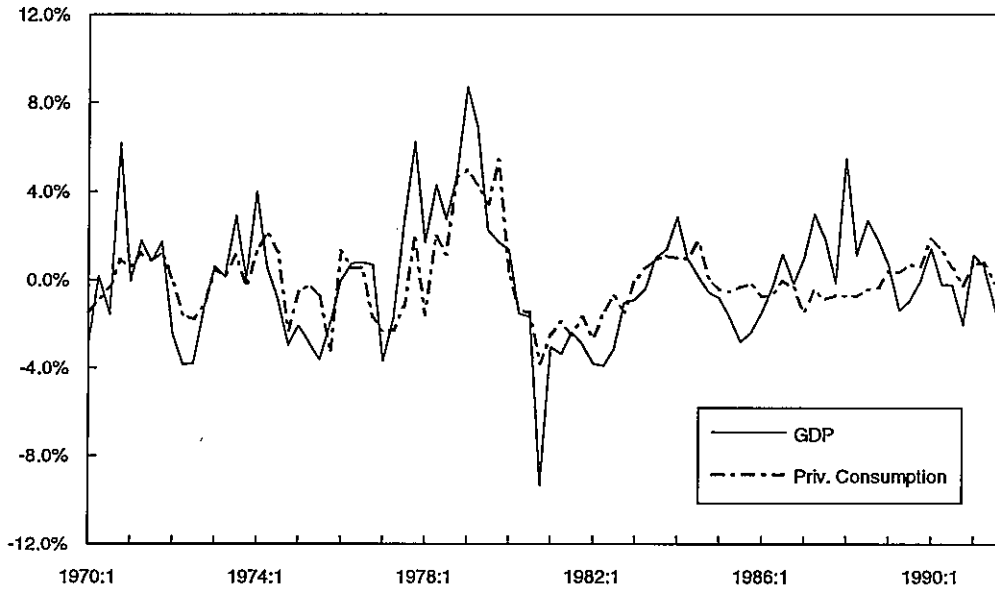
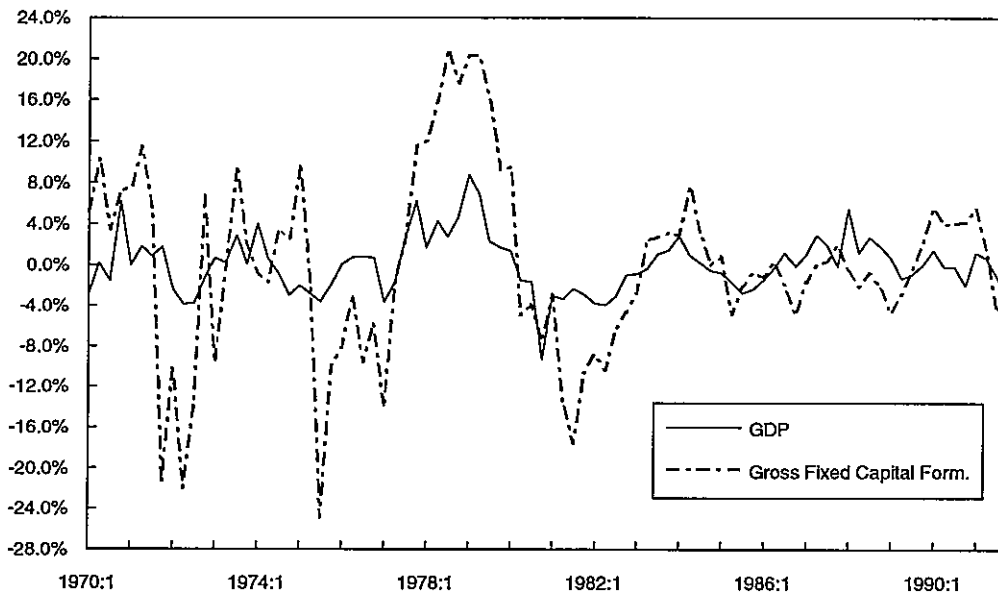


FIGURE 3: COMPARISON OF DEVIATIONS FROM TREND

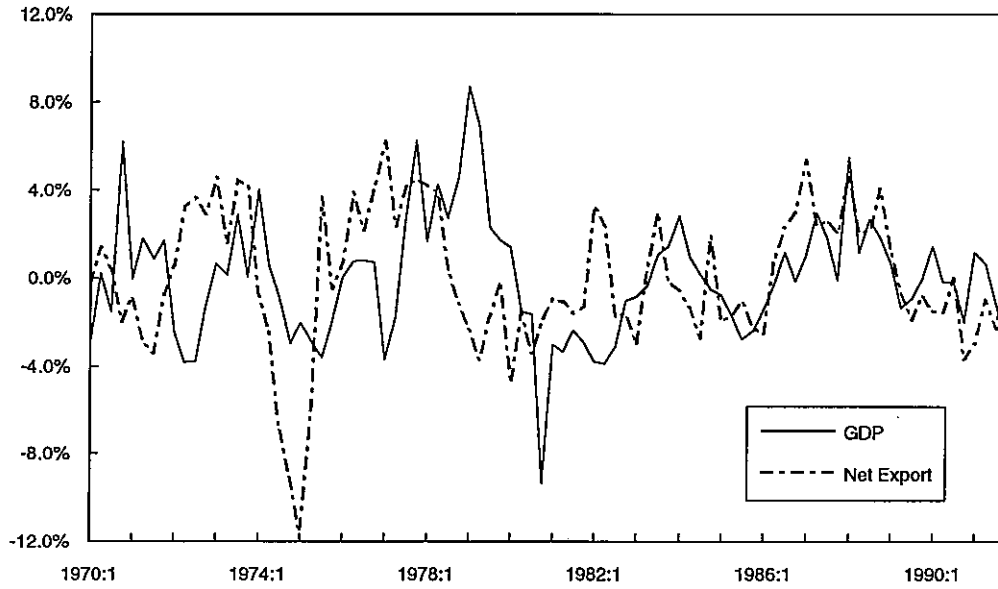


(a) Private Consumption and GDP

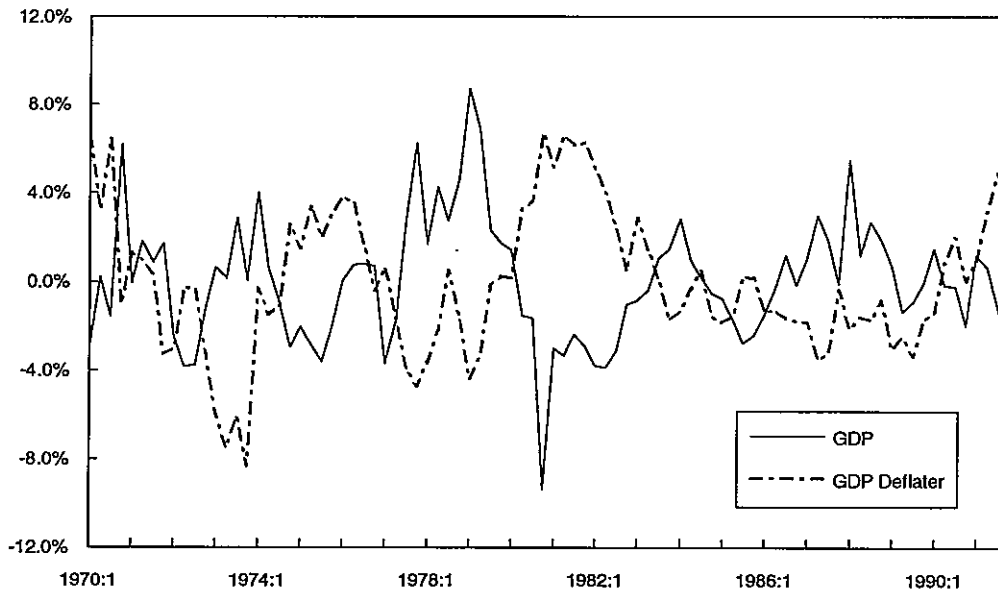


(b) Gross Fixed Capital Formation and GDP

FIGURE 3: COMPARISON OF DEVIATIONS FROM TREND

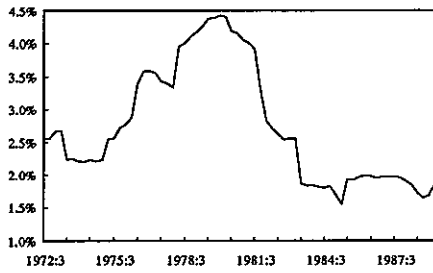


(c) Net Export Share and GDP

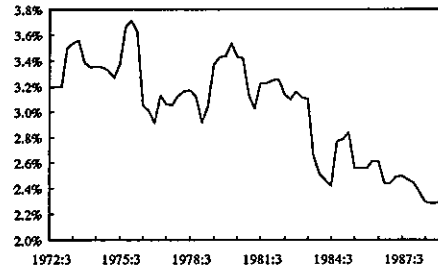


(d) GDP Deflator and GDP

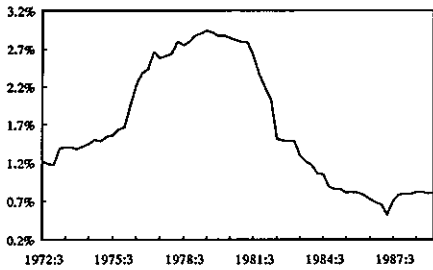
FIGURE 4: MOVING PERCENTAGE STANDARD DEVIATIONS FROM TREND



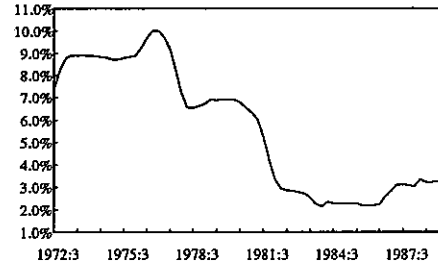
GDP



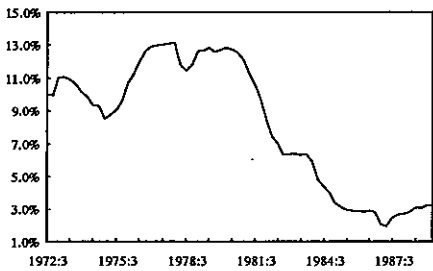
Government Consumption



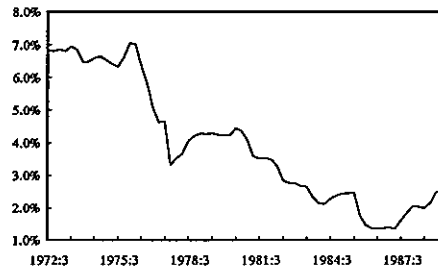
Private Consumption



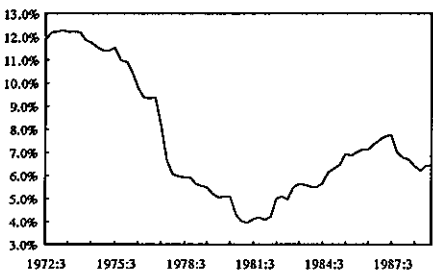
Terms of Trade



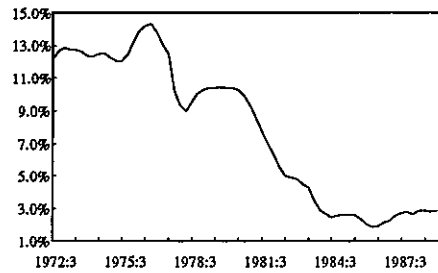
Gross Fixed Capital Formation



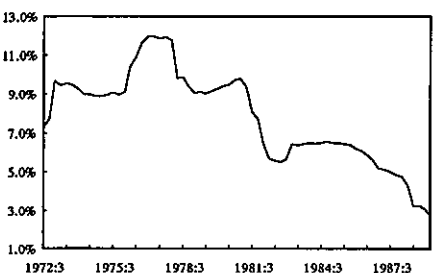
Relative Price of Exports



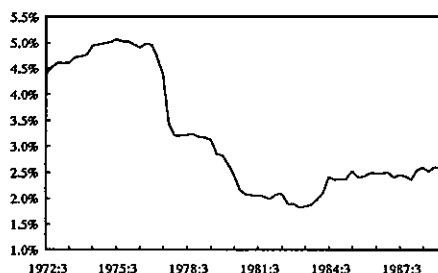
Exports



Relative Price of Imports

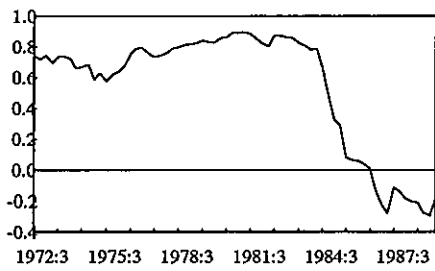


Imports

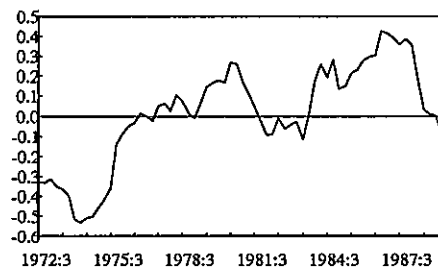


Net Export Share

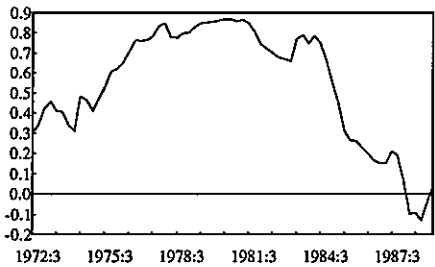
FIGURE 5: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP : Expenditure Components



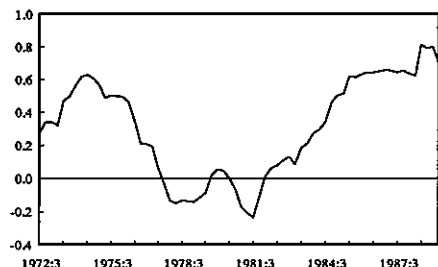
Private Consumption



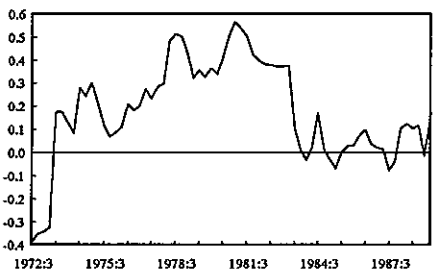
Government Consumption



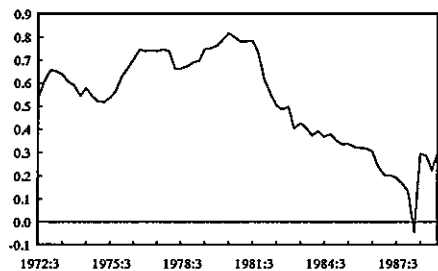
Gross Fixed Capital Formation



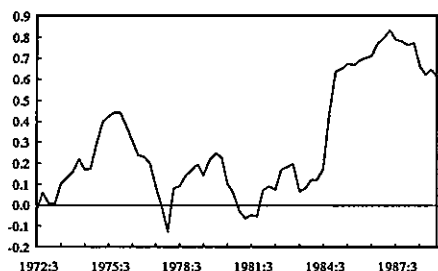
Exports



Inventories Share

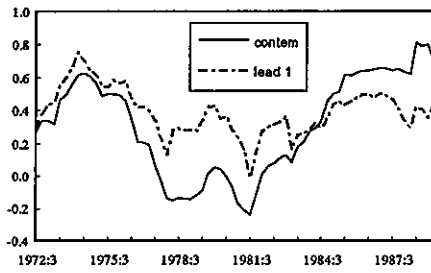


Imports

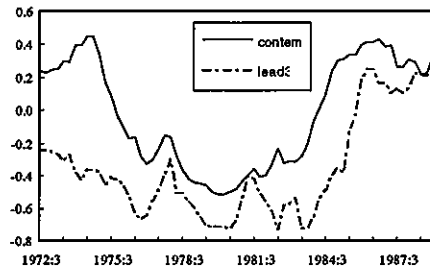


Net Export Share

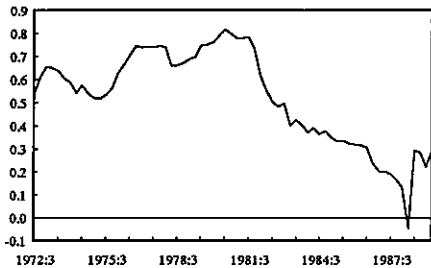
FIGURE 6: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP: Open Economy Variables



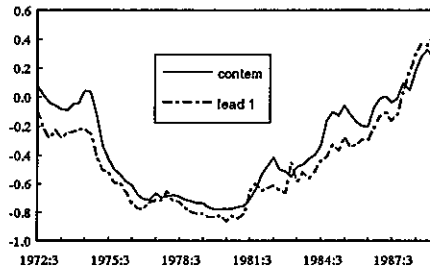
Exports



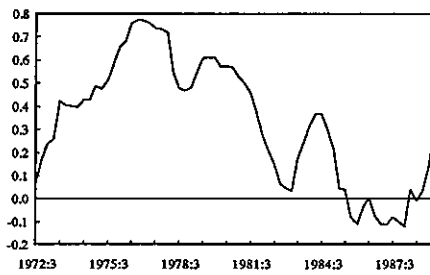
Relative Price of Exports



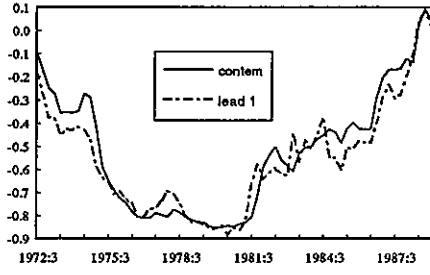
Imports



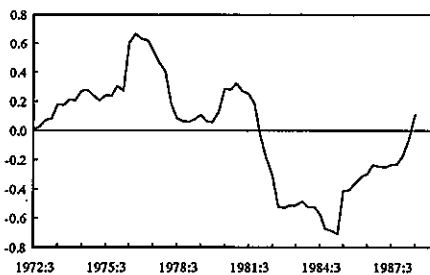
Relative Price of Imports



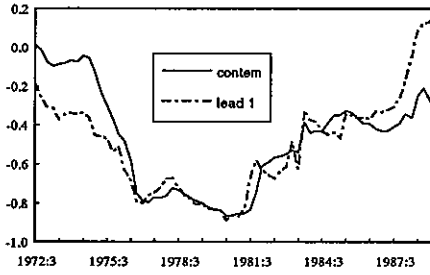
Output USA



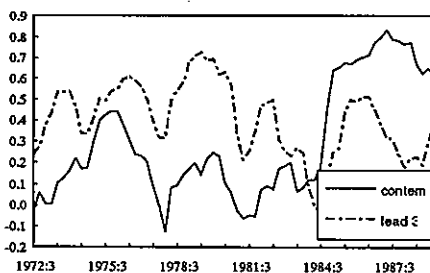
Terms of Trade



Output Japan

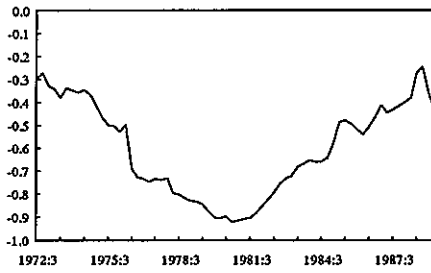


Relative Price of Oil Import

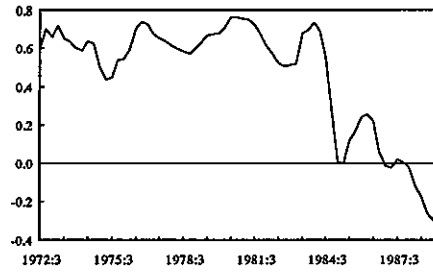


Net Export Share

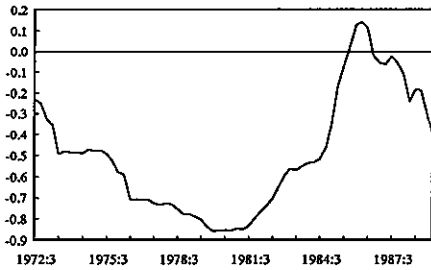
FIGURE 7: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP: Nominal and Labour Market Variables



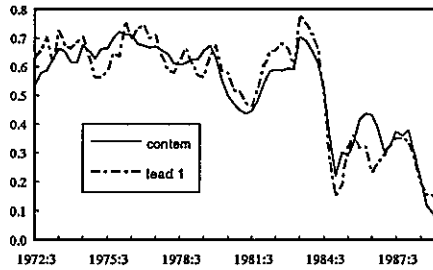
GDP Deflator



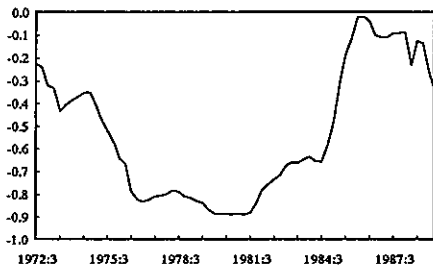
Monetary Base



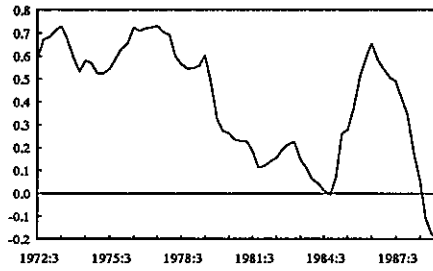
Consumer Price Index



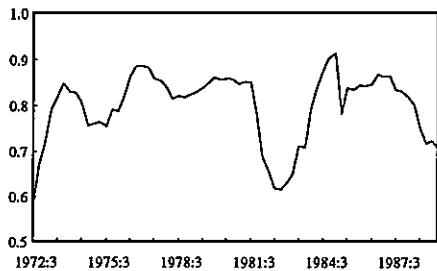
M1



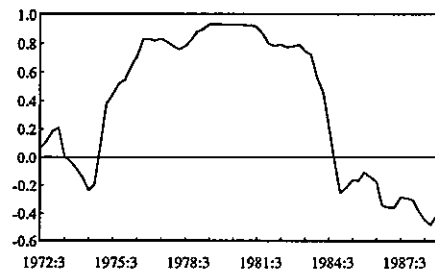
Wholesale Price Index



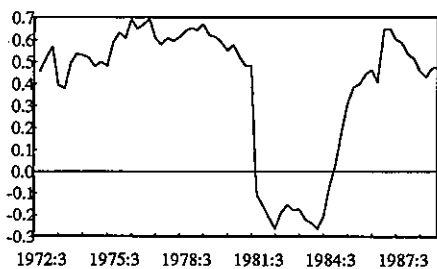
M2



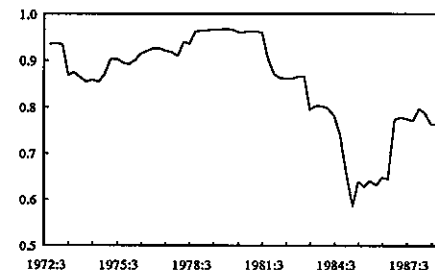
Manufacturing Output



Real Wage

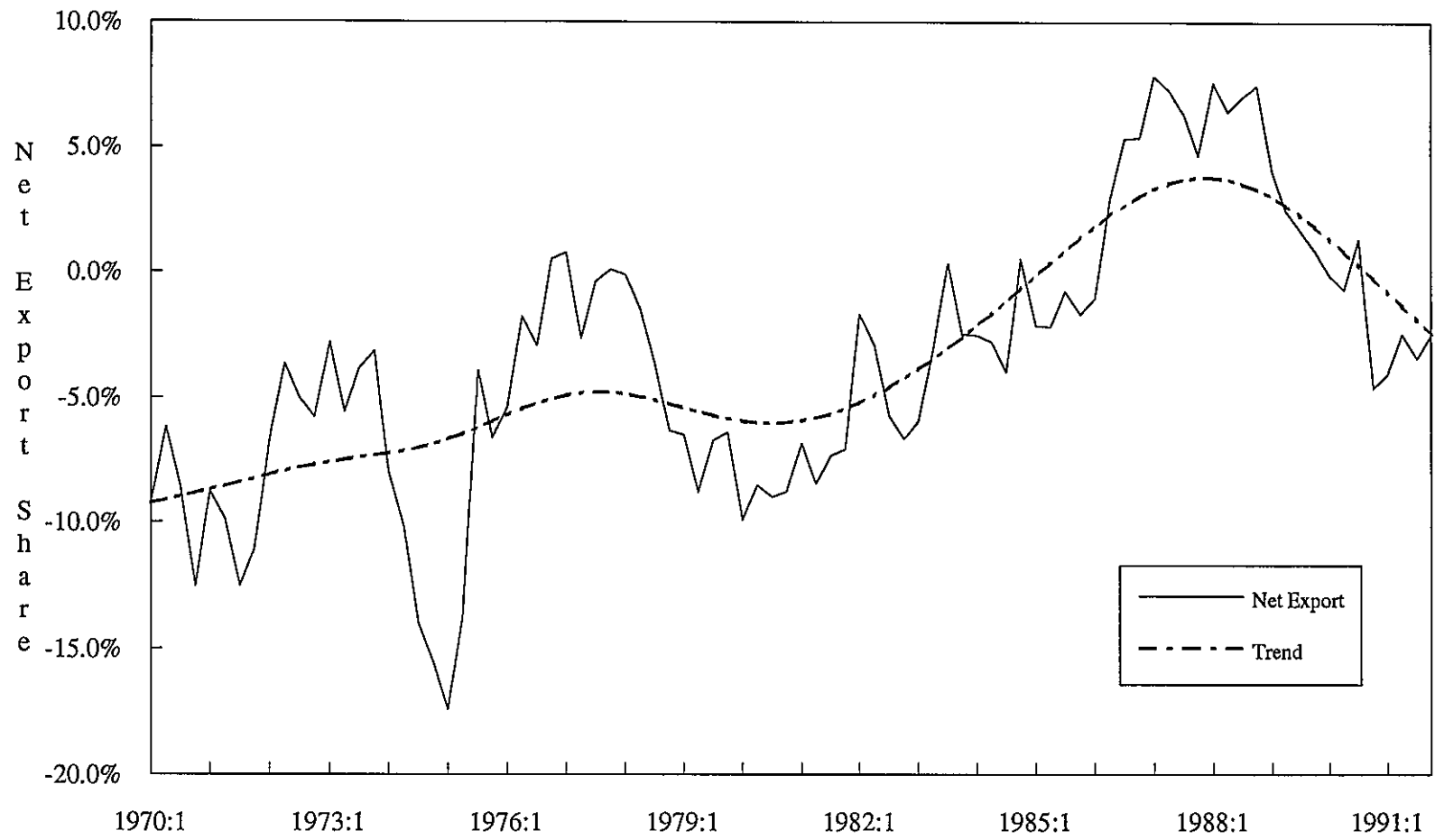


Employment



Average Labour Productivity

FIGURE 8: Net Export as a Share of GDP
1970(1) - 1991(4)



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