Exchange Rate Regimes and International Business Cycle Transmission Revisited: The Korean Experience

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Abstract----------
The purpose of this paper is to assess how the shifts of the exchange rate regime in Korea have changed the influence of foreign business cycle fluctuations on the domestic economy. Particular attention is paid to the adoption of the market average exchange rate regime in the early 1990s and the freely floating system in the aftermath of the 1997 currency crisis. The paper traces the patterns and extents of changing importance between foreign and domestic business cycles as the economy has shifted to more and more flexible exchange rate regimes. We find that despite the opening of Korea's financial market in the 1990s, the adoption of floating exchange rates may have increased the degree to which the Korean economy is insulated from the foreign disturbances.

Key Words: Exchange rate regimes, International business cycle transmission, Korea, VAR
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I. Introduction

In the aftermath of the East Asian currency crisis in 1997, most crisis-hit countries gave up the *de facto* dollar peg and let their currencies fluctuate freely. At that time, adopting the floating exchange rate was considered to be the only solution available for East Asian countries to stop the values of their currencies from free-falling. Having got around the currency crisis, though, there seems to be a revival of the debate as to whether this floating exchange rate would continue to be suitable for East Asian countries.

Theoretically, the choice of floating rates is considered optimal by many observers and economists with the expectation that greater flexibility will increase the degree to which national economies would be insulated from foreign disturbances. More than two decades of experience with the flexible exchange rate system indicates that contrary to this expectation, the international transmission of growth, inflation and unemployment has not been eliminated. In particular, the observed high degree of co-movement of the international business cycles has forced many to cast serious doubt on its insulation properties. As Baillie and McMahon (1989) witness, macroeconomic interdependence has rather increased remarkably, and domestic economies appear to be more vulnerable to external shocks, which in turn, results in a greater volatility in many macroeconomic variables.

Various theoretical developments have been proposed to demonstrate that flexible exchange rates do not insulate the national economy from foreign disturbances. See for example, Arthus and Young (1979), Dornbusch (1983), and Glick and Wihlborg (1990), among others. These authors show that foreign disturbances will affect real domestic output under flexible rates as much as under fixed rates. A vast volume of empirical work has also been documented in order to compare the transmission of business cycles across fixed and flexible exchange rate regimes. For example, Gerlach (1988) finds that output covariances between the U.S. and most other industrial nations have significantly increased following the

move to floating rates. Baxter and Stockman (1989) argue that the introduction of flexible exchange rates in the 1970s has not changed the profile of post-war business cycles for most industrial countries. In contrast, Hutchison and Walsh (1992) show that the flexible exchange rate regime is more effective in insulating the Japanese economy from foreign disturbances than is the fixed rate regime.

Thus, the insulation properties of flexible exchange rates remain in question from the aspects of both theory and empirical evidence. The purpose of this paper is to utilise the more recent data to assess this important controversy. Specifically, this paper attempts to assess the experience of Korea. This focus on Korea is motivated because Korea, a typical small open economy, adopted a series of different varieties of flexible exchange rate regimes in the 1990s and hence the insulation properties could be well examined from this experience.

Prior to 1990, Korea had experienced two different regimes of the exchange rate system. One was the fixed exchange rate system, which operated until the 1970s. The other was the multiple currency basket peg exchange rate system during the 1980s. As a variety of the crawling system, the exchange rate was determined as weighted average of major foreign currencies and the "policy factor". The year 1990 marks the beginning of a flexible exchange rate system in Korea by introducing the so-called market average exchange rate system in March. Under this system, the exchange rate (the Korean won against the U.S. dollar) was allowed to fluctuate in a pre-set daily band of plus/minus 0.4 percent. The daily fluctuation band was widened gradually with the progress of financial liberalization in the course of the 1990s.[1] It reached plus/minus 2.25 percent before the financial crisis broke in November 1997. The exchange rate became freely floating in December 1997.

This paper proceeds as follows. Section II offers a discussion on the sources and transmission channels of international business cycle. Korea's experience in that regard is

[1] The daily band was widened five times – plus/minus 0.6 percent (2 September 1991), 0.8 percent (1 July 1992), 1.0 percent (1 October 1993), 1.5percent (1 November 1994), 2.25 percent (1 December 1995).

also reported in this section. The empirical results of this study are given in Section III. Section IV offers summary and concluding remarks.

II. Sources and Transmission Channels of International Business Cycle

There are two different sources of international business cycle – supply and demand disturbances. A stark example of supply disturbances would be the oil price shocks during the 1970s, which caused a worldwide stagflation. Technology shocks are also considered as a possible source of international business cycle. Dellas (1986), for example, concludes that common shocks, such as exogenous oil shocks and technology shocks, are the driving force behind the world business cycle. In her study on international interdependence of national growth rates, Daniel (1997) shows that oil price explains a substantial portion of the short-run variation in industrial production for the U.S., the U.K. and Japan. Canova and Marrinan (1998) show that the model with technology disturbances accounts very well for the propagation of U.S., German and Japanese output shocks.

Demand disturbances such as changes in foreign income or monetary policy are another source of international business cycle. There are two different channels of transmission of foreign demand shocks across the border. The first transmission channel is through exports. The foreign business cycle has an impact on the domestic economy through changes in export demand and the terms of trade. Canova and Dellas (1993) claim that trade interdependencies in intermediate goods are important in explaining the transmission of country-specific disturbances. Recently, Anderson, Kwark and Vahid (1999) show that the business cycles of countries that are more open to international trade are more likely to be synchronised with the business cycles of their major trading partners.

Another channel of propagation of foreign demand shocks is the financial market. Foreign demand shocks may have direct impact on the domestic economic activities because

of the direct influence of foreign asset markets on the domestic asset markets. Pigott (1994) shows that if the foreign country is a large source of foreign capital inflow to the domestic economy, its real interest rates influence the domestic real interest rates, which in turn determine the domestic business cycle. Canova and De Nicolo (1995) show that expected U.S. GNP growth helps predict European stock returns, which in turn help to explain future European GNP growth. Froot and Stein (1991) find that high relative wealth of foreign companies (as a result of an increase in overseas share prices) induces an increase in foreign direct investment leading to a boost in the domestic economic activity.

It can then be inferred that demand disturbances in the countries which provide large markets for Korea's exports and take the lion's share of Korea's foreign capital inflow would be the major sources of business cycle fluctuations in Korea. Since the early 1960s Korea had pursued so-called export-oriented industrialization. Korea's exports had increased more rapidly than its GDP and as a result, its exports relative to GDP reached over 30 percent in 1974 and remained around 30-40 percent until 1997. After the currency crisis in 1997 the exports-GDP ratio rose to over 40 percent. Figure 1(a) illustrates the trends of the ratio for the period 1971:1 – 2001:1. The Figure also depicts the trends of Korean exports to the U.S. and Japan, which are normalized as the percentage of Korea's GDP. With a brief period of exception, the U.S. and Japan have been the first and second largest markets for Korean exports, respectively.[2] The shares in Korea's total exports attributable to these two countries fell since the late 1980s, but rose again after 1997. As shown in Figure 1 (a), Korean exports to the U.S., which had peaked in 1987:2 with 16.9 percent of GDP, declined till early 1997, and then again increased to hover around 10 percent in recent years. Exports to Japan have shown a similar pattern, but have been smaller than those to the U.S. except some quarters in 1973-74.

[2] This order reverses for Korean imports from these two countries.

On the other hand, Korea' s financial market had been effectively closed to foreign investors until the 1980s. In the late 1980s Korea formally accepted the obligations of Article VIII, Sections 2-4 of the IMF' s Articles of agreement. This required Korea to eliminate many restrictions on payment and transfers for current account transactions. In the 1990s, Korea undertook a gradual liberalization of its financial market. In January 1992 foreigners were allowed to purchase Korean stocks up to 3 percent of the outstanding shares of each company per individual, but no more than 10 percent of a company in total. In June 1993, the Korean government announced a blueprint for the liberalization and opening of the financial sector. The plan envisaged further easing requirements for foreign exchange transactions widening the daily won-dollar trading margins, expanding limits on foreign investment in the stock market, and permitting long-term commercial loans. In addition, during the membership negotiations to join the OECD in 1996, the Korean government was forced to open up its capital market more rapidly.

Yet, a more drastic liberalization of the financial market was pursued in the wake of the 1997 financial crisis. Under the initial IMF program, all regulations on foreign purchases of debt securities were eliminated in December 1997. At the same time, the ceiling on overall foreign ownership of stocks was raised from 26 percent to 50 percent in 1997. The individual ceiling was also raised from 7 percent to 50 percent. These ceilings were lifted completely in May 1998. Hostile take-overs by foreigners were allowed and the scope of business areas open to them widened in May 1998. All the short-term money market instruments, such as commercial papers and trade bills, were also completely liberalized in May 1998, and this has brought Korea' s capital markets on a par with the level of openness of the advanced countries.[3]

[3] See Wang (2001) for more detailed discussions on the liberalization process of Korea' s capital market.

With this liberalisation of the financial market, Korea became integrated closely with foreign financial markets and the amount of capital inflow from foreign countries increased dramatically.[4] As a result, foreign capital movement has become closely linked to the Korean domestic economic activity. Capital inflow from the U.S. and Japan took a lion's share of total foreign capital inflow. Figure 1 (b) shows the trends of the annual foreign investment (as the percentage of Korea's GDP) from these two countries during the period 1971:1-2001:1. It is noteworthy that the investment from both the U.S. and Japan, which had been relatively stable until 1997, has increased very rapidly in recent years.

III. Empirical Analysis

Data and Period of Study

Empirical analysis is undertaken using a vector autoregression (VAR) model of oil prices (Dubai product), and real Gross Domestic Products (GDP) of the U.S., Japan and Korea over the period 1970:1-2001:1. As explained in the introduction, the exchange rate in Korea became more flexible, particularly from the early 1990s. To take account of these changes in the exchange rate regime, estimates are also made separately for the sub-sample period of 1970:1 – 1989:4. The oil price is included in the model so as to account for the effect of a common supply shock. Oil price shocks may directly affect the economic activity of Korea, or indirectly through the innovations to U.S. and Japanese outputs. Our selection of the variables allows us to examine the individual effects of foreign demand disturbances (foreign income), foreign supply disturbances (the oil price) and domestic disturbances.[5] All data

[4] For example, net foreign capital inflow increased from 0.2 billion dollars in 1980 to 3.2 billion dollars in 1996 and to 15.7 billion dollars in 2000.

[5] There are at least three directions to extend the scope of the model. The first is the inclusion of technology factors. The second is the inclusion of the outputs of other countries such as EU and ASEAN countries, as these countries are also Korea's important partners in the international trade and capital movement. Finally, the introduction of country-specific monetary factors may also improve our understanding of how the changes in the

series are taken from Datastream except the Korean GDP, which is taken from the Bank of Korea database. All data are quarterly, seasonally adjusted and in the form of natural logs.

Figure 2 plots the logged GDP series of the U.S., Japan, and Korea, denoted by GDPus, GDPjp and GDPkr, respectively. For the purpose of visual comparison, the three GDPs are normalized in such a manner that their levels at the first quarter of 1970 are set at 100, respectively. This is because it is not the individual levels of the series that are of interest, but the relationships between the three series. Some features of the graph include the higher growth rate of Korean GDP relative to the other two, and divergence of the three series. The latter observation has become more evident over time, which suggests that there may not be any strong long-run relationship among the three GDP series. We will come back to this point in the subsequent statistical analysis.

Figure 3 depicts the annual growth rates of the GDPs of (a) the U.S. and Korea and (b) Japan and Korea, respectively. The U.S. and Korean GDPs move closely together until 1984, but such a co-movement becomes weaker afterwards. In contrast, the spatial connection between Japanese and Korean GDPs is mainly detectable after 1984. To have a more thorough examination, the three GDP series are passed through the Baxter and King (1995) band-pass filter. Their filter decomposes the series into three parts: low frequencies (i.e. trend component), business cycle frequencies, and high frequencies (i.e. irregular component). Figure 4 shows fluctuations of each GDP series at business cycle frequencies, six quarters to eight years, which may be viewed as deviations from a local trend. The cyclical components of Korean GDP seem to move along with those of U.S. GDP until around 1984, but more closely with those of Japanese GDP afterwards.

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exchange rate system are related with the trend of the degree to which the Korean economy has been insulated from the foreign disturbances. But a major problem from this modification is that the model would end up with too many variables.

Unit Roots and Cointegration tests

Prior to estimating a VAR model, Augmented Dickey and Fuller, and Phillips-Perron tests were conducted to determine the order of integration of the series. As reported in Table 1, both tests indicate that each series in levels is characterized as an $I(1)$ process. We then applied the Johansen procedure to test for evidence of cointegration among the series. Table 2 shows that both the trace and maximum eigenvalue tests indicate no cointegrating relationships among the series at the 5 percent significance level. It is probably not surprising that the world oil price does not cointegrate with the other three GDP series. Note that this does not rule out the possibility that oil price shocks can have significant short-run effects on the GDP series.

Of more interest are the implications of the lack of cointegration among the three GDP series. It suggests that the *levels* of the three GDP series will diverge over time. Some informal explanation for this finding may be obtained from Figure 2. The Korean GDP series has quite different behaviour from the other two, so the finding of no cointegration with Korea is justifiable. While the U.S. and Japanese GDP series do exhibit some similar behaviour in the 1970s, it can be seen that the U.S. growth rate has been consistently higher since 1984, and the disparity has continued to widen. Again, the absence of cointegration is a finding about the long-run behaviour of the levels of the series, and does not preclude the important dynamic relationships between the series, which are the focus of this paper.

Variance Decomposition

Based on the test results of unit root and cointegration, the reduced-form VAR model in the first differences of the series is estimated with four lags and a constant.[6] Then, the estimated

[6] The lag length was chosen on the basis of the Sims likelihood ratio test.

VAR are expanded to models in the levels of the series. Econometric identification of the underlying structural shocks is achieved by imposing contemporaneous restrictions of the type used typically in the standard Choleski decomposition approach. To avoid the possible ordering problem, we employ the Pesaran and Shin (1998) method in calculating dynamic interactions among the series.[7] Their method is invariant to the orderings of the variables as the identification takes full account of the historical patterns of correlations observed amongst the different shocks.

Table 3 reports the forecast error variance decompositions of Korean GDP at the forecast horizons of 1, 4, 8, 16 and 32 quarters. First look at the third column, which summarises the results for the sub-sample period of 1970:1-1989:4. Among the external disturbances, the oil shock accounts for the largest portion of the forecast error variance of Korean GDP. This effect is particularly evident in the medium and long run in which the shock explains around 30 percent of movements in Korean GDP. In contrast, the contributions of foreign demand shocks are small and statistically insignificant, particularly in the longer terms. The U.S. GDP shock explains less than 10 percent of the variability in Korean GDP at all horizons. The contribution of Japanese GDP shocks is even smaller and is statistically insignificant at all horizons. Instead the proportion of Korean GDP variance associated with its own shock remains around 60 percent at 8, 16, 32 horizons.

However, as shown in the fourth column of the table, substantial differences appear when the estimates are made for the full sample period of 1970:1-2001:1, which includes the flexible exchange rate regimes of the 1990s. The oil shock now explains only a small portion of the forecast error variance in Korean GDP. The same is also true for the shock associated with U.S. GDP. This shock accounts for less than 3 percent of the forecast error variance at all horizons. On the other hand, the shares accounted for by Japanese GDP become greater in

[7] For the sake of comparison, we also applied the Choleski decomposition approach with the ordering of oil price, U.S. GDP, Japanese GDP and Korean GDP, and obtained a very similar result (not shown).

the full sample period and are considerably larger than those by the first two shocks. Most importantly, a greater portion of the variation in Korean GDP is explained by its own shock in the full sample: 78 percent at the 8th quarter horizon and 72 percent at the 32nd quarter horizon. At all horizons, the contributions of the shock are always larger in the full sample than in the sub-sample. Inversely, the total contribution of the foreign shocks reduces as the sample period extends to include the 1990s. This implies that as the exchange rate has become flexible in the 1990s the Korean economy may have been insulated from the foreign disturbances more effectively.

In order to investigate systematically what caused such differences, a rolling regression technique is applied to the VAR model for the period of 1990:1-2001:1. The forecast error variance decomposition for Korean GDP is performed first using the data from the sub-sample period of 1970:1-1989:4, and then one additional quarter is added to the data set and the variance decomposition is generated. This process is repeated until the entire data set is exhausted. As mentioned before, the daily fluctuation band of the Korean won-U.S. dollar exchange rate was set at plus/minus 0.4 percent on 2 March 1990 when the so-called market average exchange rate system was first adopted, and was subsequently widened with the progress of financial liberalization. The exchange rate was finally floated freely in December 1997. The rolling regression analysis is useful here in that it allows us to examine the degree to which the Korean economy has been insulated from foreign disturbances as the economy has shifted to more and more flexible exchange rate regimes.

Figure 5 (a) plots the fractions of the forecast error variance of Korean GDP accounted for by the variations in oil prices, U.S. GDP, Japanese GDP and Korean GDP at a horizon of 8 quarters.[8] The date on which the sample ends is shown on the horizontal axis and the shares of the forecast error variance of Korean GDP are shown on the vertical axis. All

[8] The plots drawn at different horizons (16th and 32nd quarters) also show very similar patterns, and hence are not reported here for brevity.

estimates appear to be stable before the 1997 currency crisis. However, there are substantial changes once the observations after the crisis are added to the sample. The effect of oil shocks reduces considerably while the shock to Japanese GDP plays a far greater role in explaining the forecast error variance of Korean GDP. As a result, their relative importance in accounting for the variability of Korean GDP reverses. The portion of the variability in Korean GDP accounted for by its own shock also changes significantly once the crisis period is included. The shock now explains a larger portion of the variance in Korean GDP. It appears, hence, that the inclusion of the observations during the period of the financial crisis could be a reason for the substantially different results between the full sample and the sub-sample.

To examine this possibility further, we re-ran the full sample period with a deterministic dummy for the period of 1997:3-1998:4 to accommodate the effects of the financial crisis. The last column of Table 3 reports the forecast error variance decompositions of Korean GDP at the forecast horizons of 1, 4, 8, 16 and 32 quarters. The oil price shock now accounts for about 15 percent of the variation in Korean GDP, which is larger than that from the full sample without a dummy, but smaller than that from the sub-sample. The importance of Japanese GDP shocks reduces considerably at all horizons in parallel with the results from the sub-sample. The shares of U.S GDP shocks become larger and are similar to the sub-sample model.

The observed closeness of business cycles between Korea and Japan since the 1990s may be largely driven by the simultaneous declines of GDP in both countries during the 1997-98 crisis. The East Asian financial crisis, which started in July 1997 in Thailand, acted as the common external shock to Korea and Japan, inducing a substantial economic recession in both countries. Unlike these two countries, the U.S. GDP did not experience a major decline during the course of the crisis and hence, its connection to the Korean business cycle

weakened. This explanation also indicates that if the estimates were made without consideration for the 1997-98 crisis, the resulting large influence of Japan on the Korean business cycle might provide misleading implications about the true relationship of the business cycle transmission between the two countries.

Returning to the main theme of this paper, it is crucial to notice that the contribution of its own shocks to the forecast error variance in Korean GDP has not changed even after the control of the Asian crisis. That is, the importance of own shocks remains at the same level as the full sample model without the dummy, but is far larger than its importance in the sub-sample model. At the 8th quarter forecast horizon, for example, the portion of GDP variability accounted for by its own shock increases from 60 percent in the sub-sample model to 75 percent in the full sample model. Unlike other variables, the increased importance observed in the full sample does not appear to depend on whether the dummy is included or not. It offers support to our early observation that as the exchange rates have become more and more flexible in the 1990s the Korean economy has been insulated from the foreign disturbances more effectively.

To check the robustness of our main finding, recursive regressions with the dummy were carried out for the period of 1997:3-1998:4. Figure 5 (b) plots the fractions of the forecast error variance of Korean GDP accounted for by the variations in oil prices, U.S. GDP, Japanese GDP and Korean GDP at a horizon of 8 quarters. Clearly, the estimates after the crisis are different from those drawn from the model with the dummy. The notable exception is the contribution of its own shocks to Korean GDP, which shows an almost identical pattern even after the control of the financial crisis. This strengthens the robustness of our finding on the increased importance of its own shocks in the 1990s.

From both pictures in Figure 5, the contribution of its own shocks to the variability of Korean GDP has increased gradually as the economy moves through more flexible exchange

rate regimes in the 1990s. The increases become particularly evident with the introduction of the full floating regime in 1997. The shock now accounts for around 75 percent of the variability in Korean GDP in comparison to around 65 percent before the full floating. Taking all results together, we conclude that despite the financial market liberalization in the 1990s, flexible exchange rates have increased the degree to which the Korean economy has been insulated from the foreign disturbances. This is in contrast with the common belief that the trade and financial market liberalization may have increased Korea's dependency on the foreign disturbances.

Impulse Response Functions

To investigate further the dynamics of the insulation properties of exchange rate regimes, we calculated the impulse response functions for the sub-sample period, the full sample period, and the full sample period with the dummy for the period of the Asian financial crisis. Figure 6 depicts the responses of Korean GDP to a unit shock to each of GDPus, GDPjp, OIL, and GDPkr. Note that the sizes of the shocks for the latter two models are set to the sizes of the shocks computed from the full sample period without the dummy.

The results are in accordance with our earlier findings in general. Consider first the responses of Korean GDP to a positive shock to U.S. GDP in Figure 6 (a). As expected, this shock leads to an increase in Korean GDP. Looking across the three models, the responses in the full sample period are much weaker than in the sub-sample period. The responses of Korean GDP to a positive Japanese GDP shock are shown in Figure 6 (b). Again, Korean GDP increases in line with the common wisdom. While the responses are quite large in the full sample, they become much smaller once the model includes the dummy for the Asian financial crisis. Figure 6 (c) shows that a rise in the oil price leads to a fall in Korean GDP. Finally, Figure 6 (d) shows that the responses of Korean GDP to its own shock are very

similar in the full sample, irrespective of whether the dummy is included in the model or not. The responses in the sub-sample period have somewhat different magnitudes.

IV. Concluding Remarks

Different exchange rate regimes are likely to result in different fabric and degree of the international business cycle transmission. The purpose of this paper is to empirically assess whether the shifts of the exchange rate regime in Korea have changed the influence of foreign business cycle fluctuations on the domestic economy. Particular attention is paid to the adoption of the market average exchange rate regime in the early 1990s and the freely floating system in the aftermath of the 1997 financial crisis. A major rationale for the world-wide movement to free floating exchange rates lies in the expectation that greater flexibility would increase the degree to which national economies would be insulated from foreign disturbances. The paper traces the patterns and extents of changing importance between foreign and domestic business cycles as the economy has shifted to more and more flexible exchange rate regimes.

The major finding of the paper is that the degree to which the Korean economy is insulated from the foreign disturbances has increased as the economy shifted to more and more flexible exchange rate regimes. Our rolling regression results reveal that the portion of the variability in Korean GDP accounted for by its own shock has increased steadily since the adoption of the market average exchange rate regime in the early 1990s. The increases become particularly evident with the introduction of the full floating regime in 1997. From the early 1990s, Korea has experienced a substantial liberalization in both trade and finance markets. In contrast to the conventional belief, our analysis shows that despite the market liberalization in the 1990s, flexible exchange rates have increased the degree to which the Korean economy has been insulated from the foreign disturbances.

In conclusion, our findings suggest that a free floating exchange rate system is superior to a fixed exchange rate system in terms of its ability to insulate the domestic economy from foreign disturbances. Thus, our findings lend support to the choice of floating exchange rates for Korea and possibly for other East Asian countries.

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Table 1. Unit root tests

(a) Augmented Dickey-Fuller Unit Root Tests

Variables	Levels		First Differences	
	No trend	Trend	No trend	Trend
1970:1-1989:4				
GDPus	-0.16	-2.88	-3.54**	-3.71**
GDPjp	0.10	-2.99	-4.01**	-4.01**
GDPkr	0.01	-1.89	-3.81**	-3.71**
Oil price	-2.41	-1.54	-3.91**	-4.50**
1970:1-2001:1				
GDPus	0.01	-3.12	-4.51**	-4.71**
GDPjp	-1.81	-0.81	-3.59**	-4.14**
GDPkr	-1.42	-1.70	-4.73**	-4.83**
Oil price	-2.65*	-2.76	-5.35**	-5.52**

* Significant at the 10 percent level (-2.57 for no trend / -3.13 for trend)
** Significant at the 5 percent level (-2.88 for no trend / -3.43 for trend)

(b) Phillips and Perron Unit Root Tests

Variables	Levels		First Differences	
	No trend	Trend	No trend	Trend
1970:1-1989:4				
GDPus	-0.21	-2.26	-6.34**	-5.92**
GDPjp	-0.60	-3.02	-8.10**	-8.00**
GDPkr	0.39	-2.13	-9.51**	-9.42**
Oil price	-2.28	-1.50	-8.23**	-8.44**
1970:1-2001:1				
GDPus	-0.01	-2.65	-8.16**	-7.73**
GDPjp	-2.09	-0.47	-9.39**	-10.04**
GDPkr	-1.05	-1.74	-9.89**	-9.89**
Oil price	-2.84*	-2.54	-10.34**	-10.38**

* Significant at the 10 percent level (-2.57 for no trend / -3.13 for trend)
** Significant at the 5 percent level (-2.88 for no trend / -3.43 for trend)

Table 2. Johansen Cointegration Tests

	Trace tests		λ-max tests	
	1970:1-1989:4	1970:1-2001:1	1970:1-1989:4	1970:1-2001:1
R = 0	46.88	36.08	27.03	21.42
R ≤ 1	19.07	14.66	11.34	11.49
R ≤ 2	7.73	3.17	7.21	3.16
R ≤ 3	0.52	0.01	0.52	0.01

Critical values for the trace and λ-max test statistics are drawn from Osterwald-Lenum (1992).

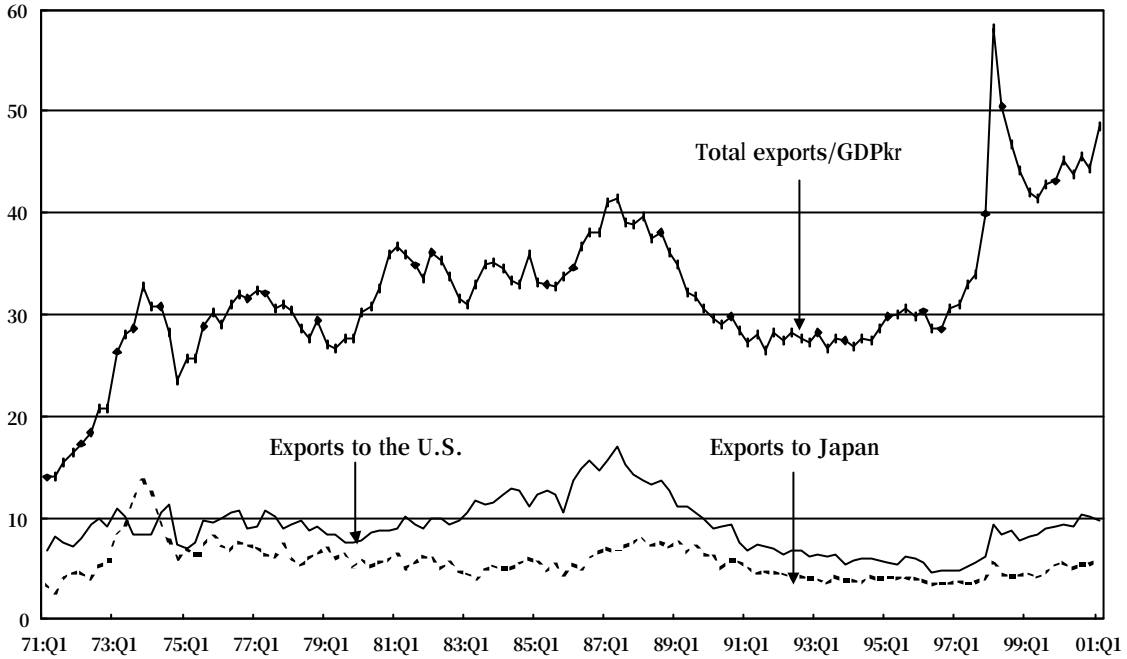
* Significant at the 5 percent level

Table 3. Forecast Error Variance Decompositions of GDPkr

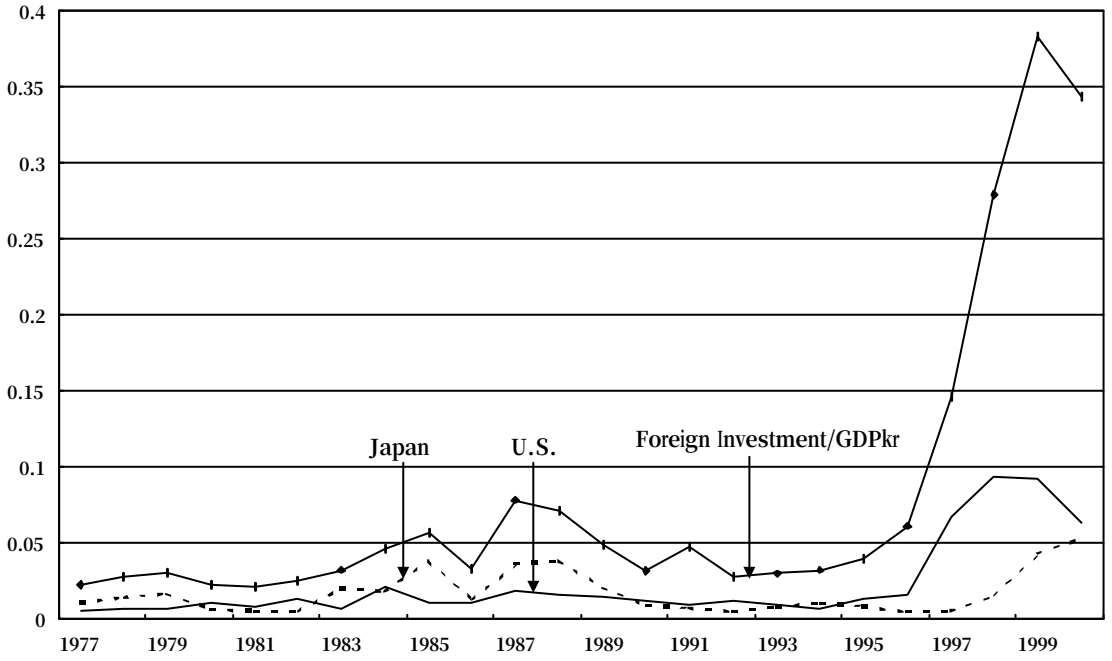
Vars.	Qtrs.	1970:1-1989:4	1970:1-2001:1	1970:1-2001:1 (D)
OIL	1	1.20	1.31	1.30
		(2.1)	(1.6)	(1.3)
	4	7.85	0.83	3.13
		(10.1)	(4.5)	(3.5)
	8	25.75	4.90	13.30
		(15.0)	(8.3)	(7.4)
	16	29.42	4.63	14.97
		(19.1)	(10.8)	(10.1)
	32	30.33	4.43	15.97
		(22.7)	(10.9)	(12.8)
GDPus	1	0.01	0.04	0.16
		(3.4)	(2.5)	(2.1)
	4	9.07	2.83	6.76
		(6.8)	(6.8)	(4.6)
	8	9.32	2.24	7.83
		(6.1)	(9.4)	(6.4)
	16	6.44	1.28	6.58
		(8.0)	(11.4)	(7.9)
	32	4.74	0.82	6.04
		(9.3)	(14.4)	(9.7)
GDPjp	1	0.26	0.02	0.35
		(1.7)	(1.4)	(0.9)
	4	2.77	6.88	1.74
		(3.8)	(4.8)	(2.9)
	8	5.79	14.42	3.98
		(8.0)	(8.9)	(4.1)
	16	3.62	19.10	4.01
		(11.7)	(13.4)	(4.8)
	32	2.35	22.98	4.16
		(13.1)	(19.8)	(5.7)
GDPkr	1	98.53	98.63	98.17
		(4.1)	(3.3)	(2.4)
	4	80.31	89.46	88.36
		(11.1)	(8.5)	(6.8)
	8	59.14	78.43	74.87
		(15.6)	(14.0)	(12.2)
	16	60.52	74.99	74.44
		(20.0)	(17.6)	(15.4)
	32	62.58	71.77	73.84
		(23.1)	(20.5)	(18.4)

Figures in parentheses are one-standard errors computed using 500 bootstrap replications of the model. The model denoted with (D) includes deterministic dummies for the period of 1997:3-1998:4.

Figure 1. Exports and Foreign Investment

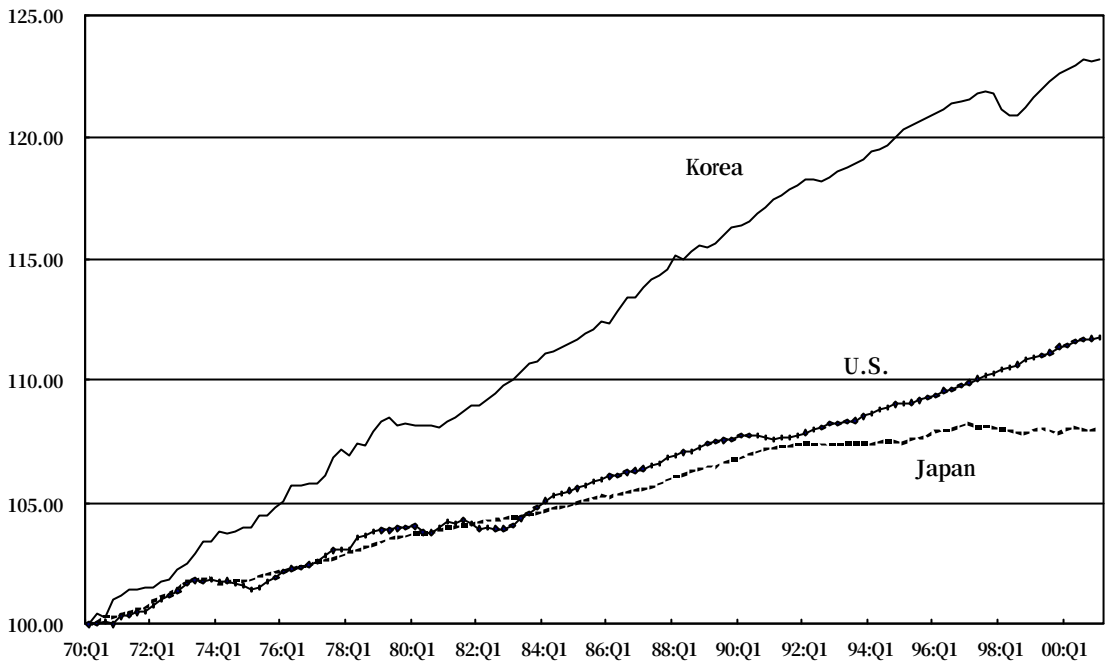


(a) Shares of Exports to the U.S. and Japan (as percentage of Korea' s GDP)



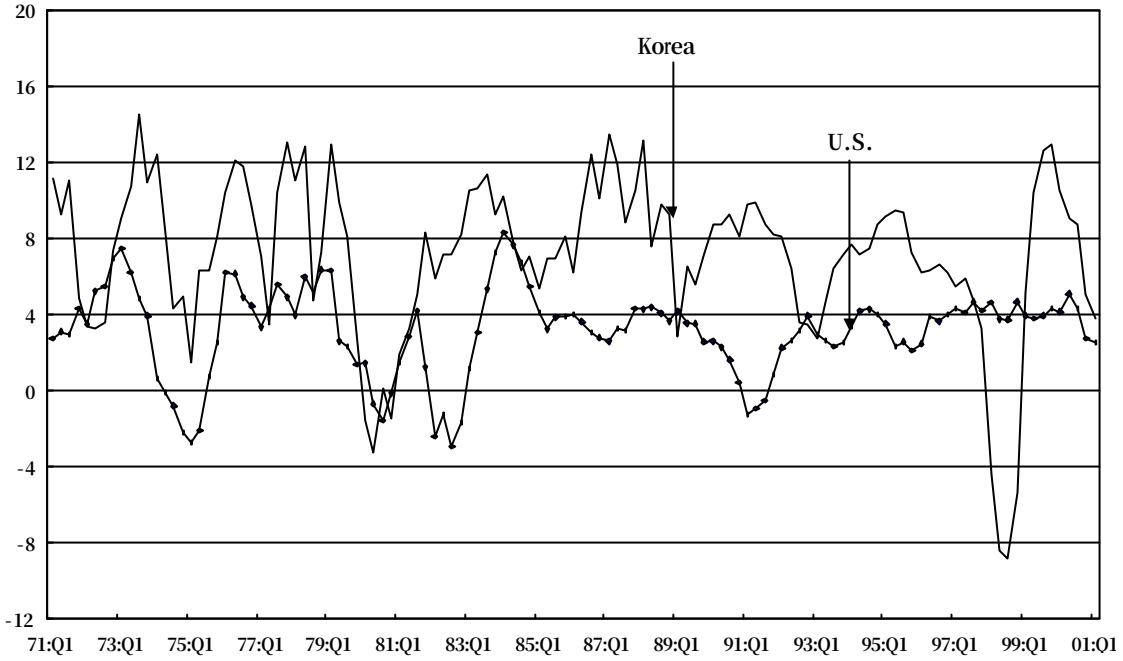
(b) Shares of Foreign Investment from the U.S. and Japan (as percentage of Korea' s GDP)

Figure 2. Korea, Japanese and U.S. GDP

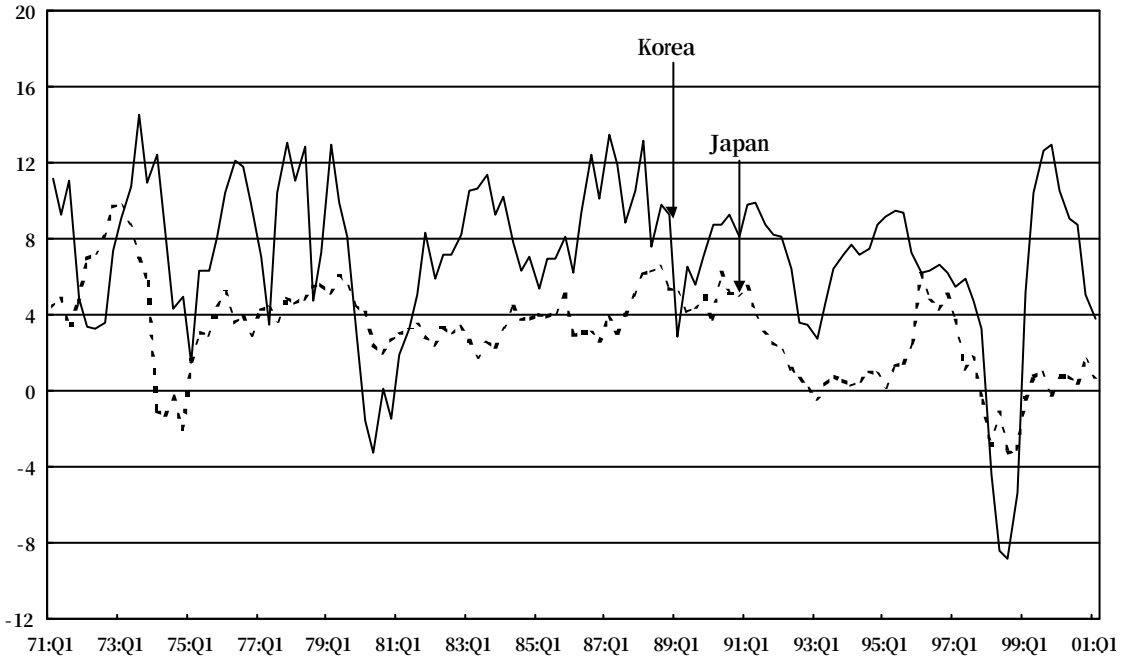


All GDP series expressed in logarithmic form are normalized on their respective starting values.

Figure 3. Annual growth rates of GDP series

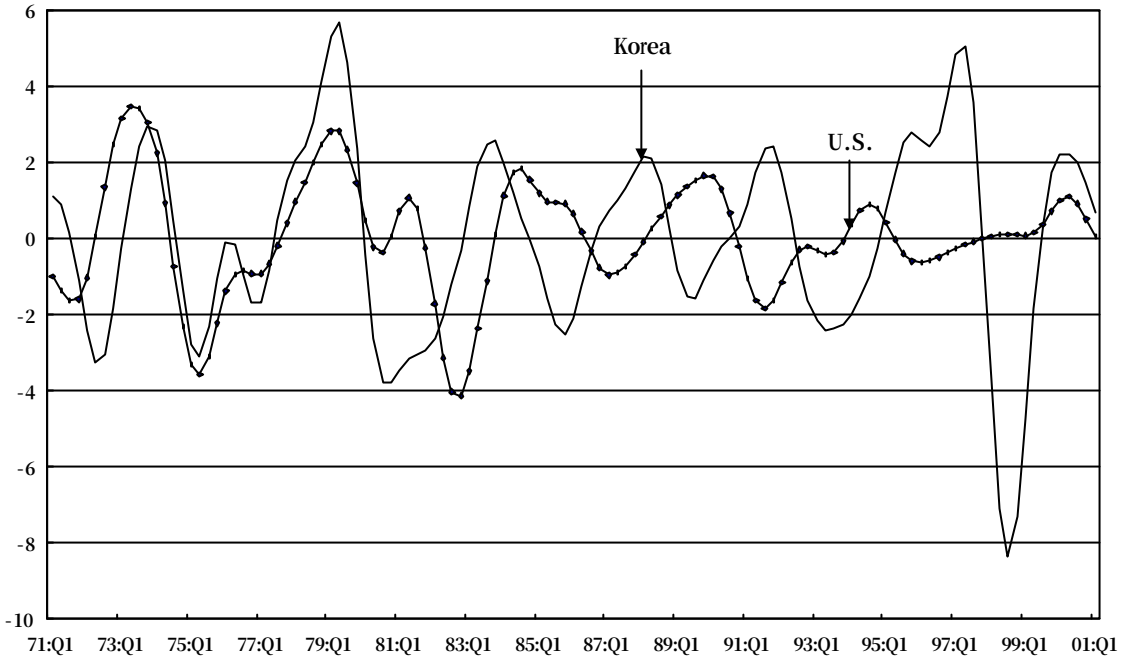


(a) Korea and the U.S.

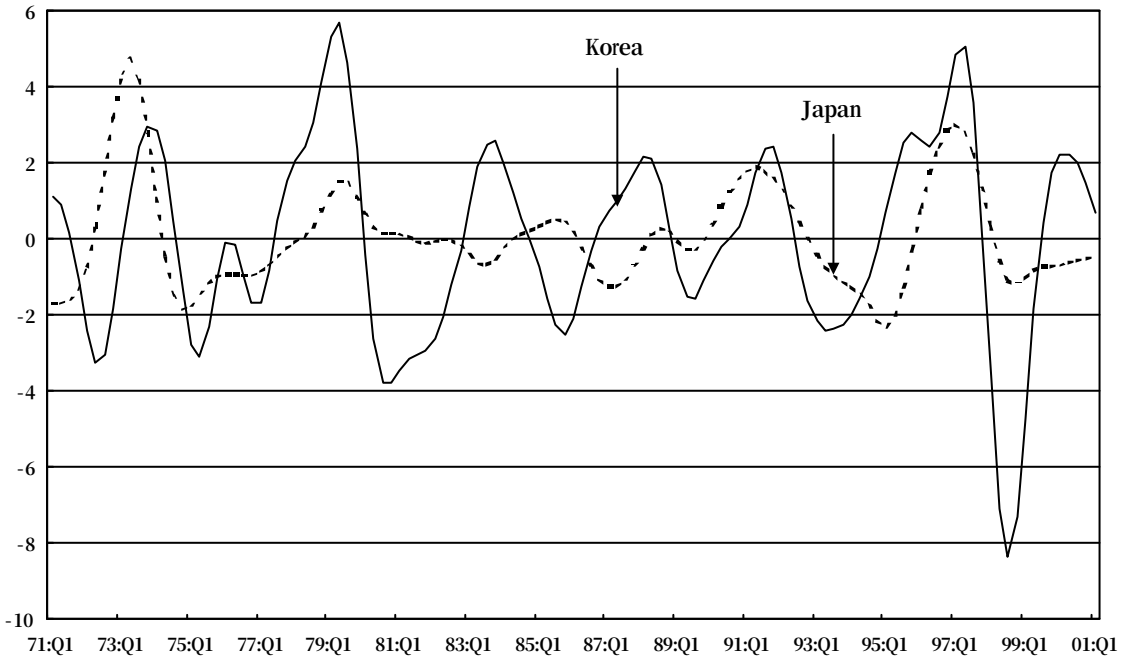


(b) Korea and Japan

Figure 4. Cyclical GDP series

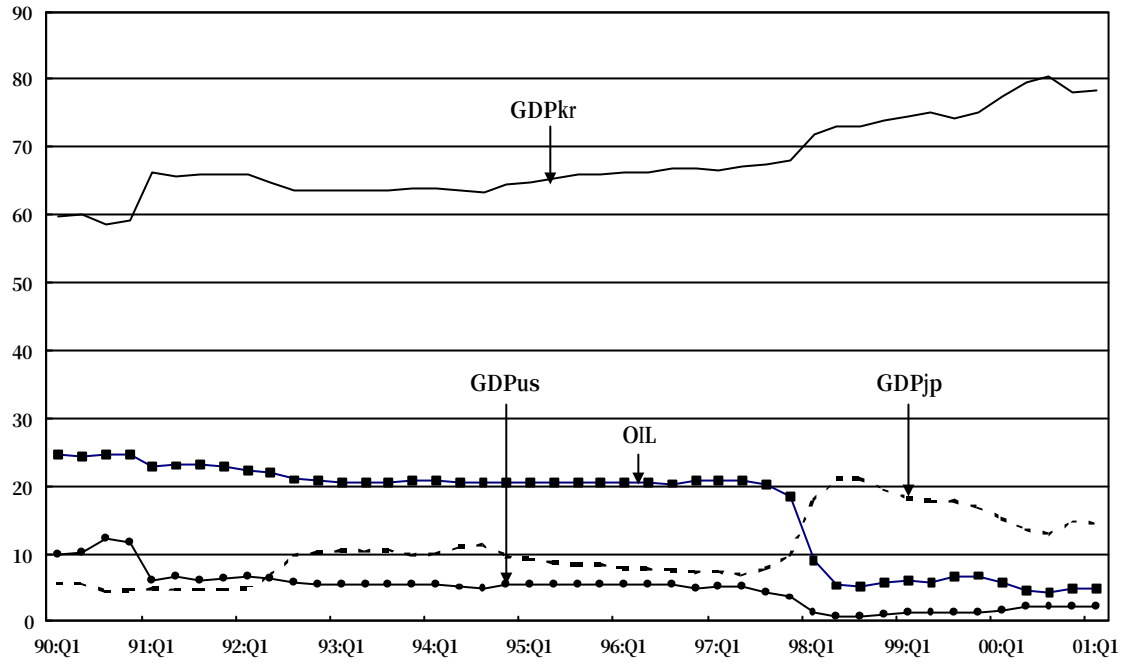


(a) Korea and the U.S.

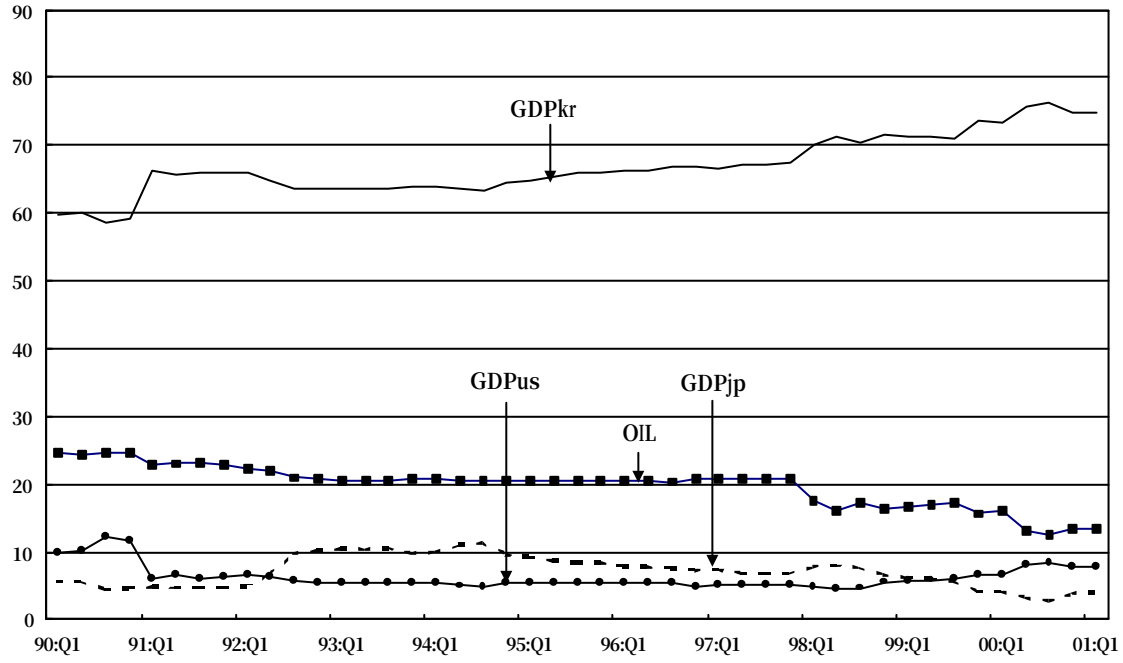


(b) Korea and Japan

Figure 5. Recursive Variance Decompositions at a Horizon of 8 Quarters

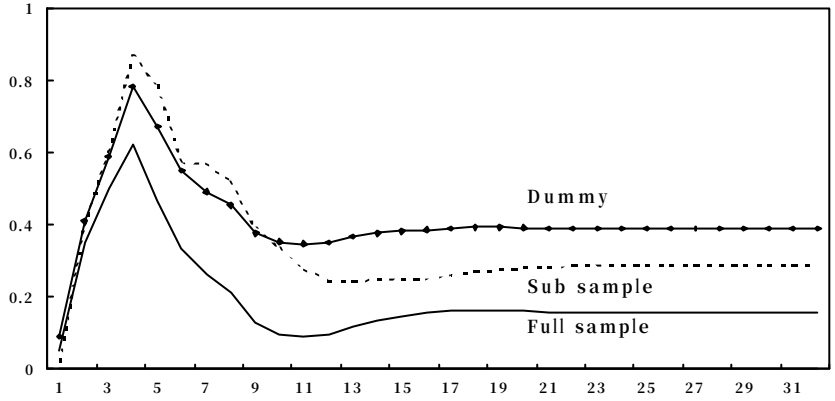


(a) Without dummy

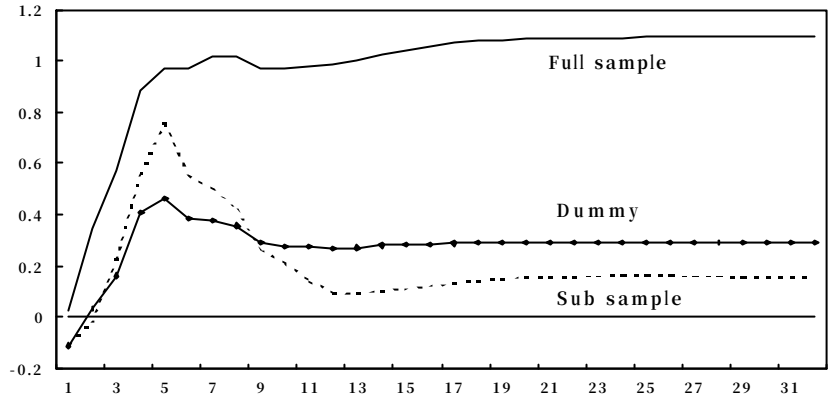


(b) With dummy for the financial crisis (1997:3-1998:4)

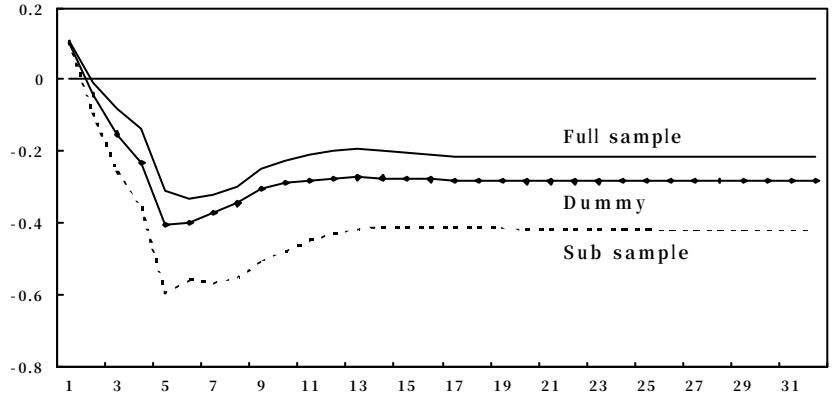
Figure 6. Responses of GDPkr



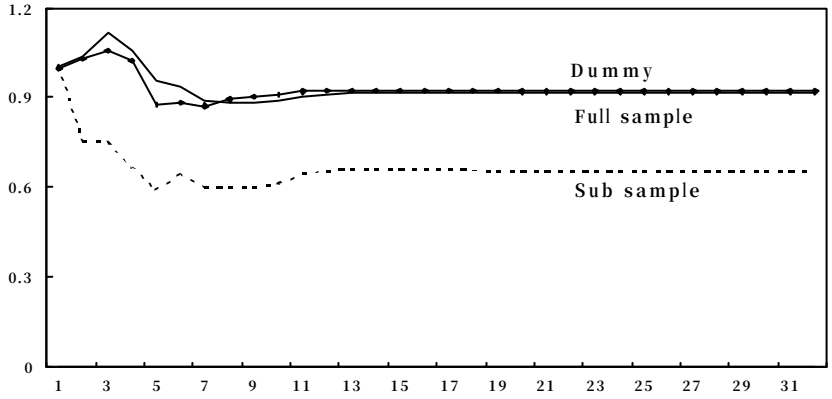
(a) GDPus Shock



(b) GDPjp Shock



(c) OIL Shock



(d) GDPkr Shock