Openness, Growth and Inflation:
Evidence from South Korea before the Economic Crisis

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Abstract

The effects of increasing openness on economic growth and inflation are examined for the South Korean economy before the economic crisis of 1997/98. The framework of analysis is a seven-variable vector autoregressive model. The impulse response functions indicate that a shock to openness has negative effects on the growth rates of output and of the price level, but no longer-run effects. The variance decompositions also indicate significant effects on these variables, and the results appear to be robust across lag lengths, variable orderings, and alternative openness measures. The negative output effect of increasing openness appears to be consistent with some models in which increased international competition due to openness may cause domestic investment to shrink and its reduction would be greater than an increase in capital inflows. In this case, net investment falls. The negative price effect of openness is also consistent with the general belief that increasing openness reduces tariffs and hence lowers import prices. The decrease in net investment also reduces the price level.

Keywords: openness, growth, inflation, variance decompositions, impulse responses

JEL classification: F43, O11, O53

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I. Introduction

Until the end of 1997, a rapid growth of the South Korean economy was accompanied by a strong government intervention in international trade as well as a government control in financial markets. The government intervention in the 1960s and 1970s encouraged domestic investment along the lines of comparative advantage in international trade. In particular, tax exemptions were given to labor-intensive manufacturing industries to enhance exports, while high tariffs were imposed on the imports of final goods to protect infant domestic industries. During this period, financial markets were also restricted to foreign investors. For example, foreign direct investment, as well as indirect portfolio investment, was very limited in Korea.

In the 1980s, the government's protection policy was maintained to be strong for another decade. More specifically, government-initiated research and development led to the development of advanced technologies domestically. University education was focused more on basic sciences, and more incentives were given to science and engineering majors. During this period, foreign investment in general (capital inflows and outflows) were still limited in South Korea. However, in the early 1990s, the world trade organization (WTO) compelled South Korea to remove trade barriers, particularly to accelerate the removal of import restrictions on foreign products. Financial markets were also forced to open to foreign investors due to the international monetary fund's (IMF) bailout packages during the economic crisis of 1997/98.

The impetus for much of the increasing pressure to open the economy is the 'new' growth theories, which suggest that a country's openness to world trade improves domestic technology, and hence productivity rises (e.g., Grossman and Helpman, 1991; Romer, 1992; Barro and Sala-i-Martin, 1995). Many cross-country studies provide evidence that increasing openness has a positive effect on GDP growth (Edwards, 1992, 1993, 1998; Sachs and Warner, 1995; Sala-i-

Martin, 1997; Frankel and Romer, 1999, among others), while robust positive relationships are difficult to find (Levine and Renelt, 1992; Harrison, 1996; Harrison and Hanson, 1999; O'Rourke, 2000, among others). Increasing openness is also believed to reduce inflation rates (Romer, 1993), because the harms of real depreciation will be greater if an economy is more open to the world, and hence monetary policy makers may have less incentives to pursue an expansionary policy. In this case, inflation falls. This proposition is well supported by empirical evidence that increased openness generally exerts a significant negative effect on inflation across countries (Romer, 1993; Lane, 1997; Terra, 1998).

Most studies of the macroeconomic role of openness have focused upon the estimation of cross-country averages of many different levels of economies. Although the cross-country studies are appropriate to examine the long-run relationships between openness and growth and openness and inflation, these studies cannot identify country-specific differences among less developed countries (LDCs). Most LDCs are similar to each other, but these countries may have their own trade policies, and their socio-economic characteristics may also be quite different among LDCs. It thus appears that the impact of openness must be studied on a country-by-country basis. One such economy well suited to the study of the macroeconomic effects of openness is the Korean economy, which has grown rapidly over the last several decades and has simultaneously run government intervention in international trade as well as in financial markets. Although the Korean economy has been characterized by rapid growth of economic activity and government intervention, relatively few studies have conducted the effect of government intervention in Korea. Lee (1995) and Kim (2000) estimated the effect of tariffs on productivity growth using micro-level data of Korean manufacturing industries, and both studies found that high tariffs had negative, but statistically insignificant effects on productivity.

This paper goes further, by using time-series macroeconomic data and by examining the dynamics of both openness-growth and openness-inflation relations simultaneously. The dynamics are examined through computation of variance decompositions (VDCs) and impulse response functions (IRFs), which are based on the moving average representations of a seven-variable vector autoregressive (VAR) model of the Korean economy. The seven variables included in the model are consistent with a reduced form of the aggregate demand-aggregate supply framework, where the IS-LM model underlies the aggregate demand side. Openness, output, the price level, the money supply, and government spending are included in the model as are two external shock variables. The latter two variables measure foreign output and price shocks emanating from the output of industrial countries and from world export prices, respectively. To check on the robustness of the results, four different measures of openness are employed: first two measures are proxies for openness to international trade, while two other measures reflect financial market openness.

The VAR modeling approach is employed since there is little agreement on the appropriate structural model and since few restrictions are placed on the way in which the system's variables interact in estimation of the system. In specification and estimation of the model, all variables are treated as jointly determined; no *a priori* assumptions are made about the exogeneity of any of the variables in the system at this stage of analysis. However, in computation of the IRFs and VDCs, some decisions about the structure must be made. These decisions are discussed in Section IV, but the results are not sensitive to the decisions made about the structure.

Section II specifies an empirical model and describes the data set used. Section III presents basic IRF results. Section IV discusses the robustness of the results using the VDCs. Major findings are summarized in Section V.

II. Model Specification and Data

A. Vector Autoregressive (VAR) Model

A vector autoregressive process of order p, VAR(p), for a system of k variables can be written as

$$X_t = A + B(L)\, X_t + u_{t,} \tag{1}$$

where X_t is a k x 1 vector of system variables, A is a k x 1 vector of constants, B(L) is k x k matrix of polynomials in the lag operator L, and u_t is a k x 1 vector of serially uncorrelated white noise residuals. As noted earlier, the standard Sims (1980) VAR is an unrestricted reduced-form approach and uses a common lag length for each variable in each equation. That is, no restrictions are imposed on coefficient matrices to be null, and the same lag length is used for all system variables.[4]

Following Romer (1993) that uses the imports/GDP ratio as an openness measure in his cross-country study, the same type of openness measure is used here in time series as a proxy for changes in the degree of openness over time. In this case, imports are used rather than exports because exports can be promoted even if imports are restricted. For example, even protected economies like Japan and Korea expanded exports under the government's protection during the 1960s and 1970s. Thus, the export share in GDP is removed from total trade. Unlike a trade share in GDP, the import share reveals import penetration to the domestic economy from the rest of the world. Therefore, the imports/GDP ratio in time series may represent a country's openness to world trade over time.

Since macroeconomic policies that are not directly related to international trade may even cause a positive correlation between openness and growth (e.g., Levine and Renelt, 1992), domestic monetary and fiscal policy variables are included in the model as control variables and allow them to influence aggregate demand. M1 is used as a monetary policy variable. Real government expenditures are measured as the consumption and investment of the consolidated central government in Korea and are deflated by the GDP deflator (1990=100). It is important to include M1 and government expenditures in the model since the monetary and fiscal policy variables can affect economic activity even if openness has no effect on real output.

Because the Korean economy heavily depends on international trade, it is also important to include variables like the foreign output and price shocks (e.g., Jin and McMillin, 1994). The foreign output shock variable, YSTAR, is the industrial production index of industrial countries. The inclusion of YSTAR in our model is similar to Genberg, Salemi, and Swoboda (1987) who used an index of European industrial production to measure a foreign output shock variable in their study of the effects of foreign shocks on the Swiss economy. The foreign price shock variable, PSTAR, is the world commodity price index of all exports. A shock to PSTAR can be transmitted to the domestic economy through two different channels. First, an increase in foreign prices may raise domestic exports but lower import demand, and hence, the net exports may rise domestically. This transmission channel relates to an increase in aggregate demand in which domestic output and prices rise through an increase in net exports. Second, the foreign price shock may reduce aggregate supply because the import prices of raw materials and intermediate goods to be used in the domestic production process will be increased. Other things being equal, this would tend to reduce domestic output but raise the price level.

B. The Korean Data

The macroeconomic effects of openness are examined within the context of a seven-variable VAR as a small macro model of the Korean economy. The model is specified and estimated using quarterly data for 1960:1-1997:3. The period 1960:1-1963:1 is used as presample data to generate the lags in the VAR, and the model is estimated over the period 1963:2-1997:3. The beginning of our sample roughly coincides with the period in which the Korean government placed increased reliance on international trade. Our sample ends in the third quarter of 1997, the one right before the breaking out of 1997 economic crisis in Korea.

Quarterly data are used for two reasons. First, the size of the VAR system requires quarterly data in order to have enough degrees of freedom for estimation. The second reason is based on a desire to minimize any problem with temporal aggregation (see Christiano and Eichenbaum, 1987) that might arise with the use of annual data. In addition, the quarterly series is seasonally unadjusted. As pointed out by Sims (1974) and Wallis (1974), seasonally adjusted data may create distortions in the information content of the raw data and render valid inferences somewhat difficult. More specifically, several varied procedures to remove seasonal components from the raw data may generate the series to be different, depending on the methodology and time periods used. Therefore, use of seasonally unadjusted data is warranted to avoid the smoothing problems inherent in the process of seasonal adjustment.

The VAR model includes seven variables. Real gross domestic product (GDP) in 1990 prices is used as real output (y). The GDP deflator (1990=100) is used as the price level (P). The narrowly defined money supply M1 is used as a monetary policy variable (M). Real government expenditures, deflated by the GDP deflator, are used as a fiscal policy variable (g). The imports/GDP ratio is used as a proxy for openness measure (OPEN). The industrial production index of industrial countries is used as a proxy for foreign output shocks (YSTAR), and the world commodity price index of all exports for foreign price shocks (PSTAR). The data for all variables are obtained from the *international financial statistics* produced by IMF. More details are available in appendix.

Prior to estimation of the VAR, augmented Dickey-Fuller tests were employed to check for first-order unit roots. These tests suggested that the first differences of the logs of YSTAR, PSTAR, M, G, Y and P and the first differences of the level of OPEN should be used in specifying and estimating the model. Following conventional methods, logarithm was not taken for the openness measures that were all in ratios. First differences of the ratios in time series then represent changes in the degree of a country's openness over time. Based upon the arguments of Engle and Granger (1987), cointegration tests were also performed for the seven variables that required differencing to achieve stationarity. Since no evidence of cointegration was found, the system was estimated with first differences of all system variables.[5]

Table 1 shows some descriptive statistics for all seven variables used. Log differences of quarterly series, $\ln X_t - \ln X_{t-4}$, generate year-on-year growth rates for all variables. While imports were about 25 percent of GDP on average (Figure 1), the annualized average changes in the imports/GDP ratio were 0.6 percentage points over time (Table 1). The average annual growth rate of real GDP was 8.27 percent over the entire sample period used, and inflation rates were 12.12 percent on the average. These growth rates in Korea were relatively high compared to those in industrialized economies, since the growth rates of YSTAR and PSTAR were found to be 3.34 and 3.41 percents, respectively. The growth rates of M1 and real government expenditures were also relatively high, 19.94 and 9.43 percents, respectively, over time.

It often is useful to examine whether a given time series approximates the normal distribution. For all series, the mean and the median were nearly equal, except for PSTAR. The kurtosis statistics that provide a measure of the thickness of the tails of a distribution were in most cases less than 3. The skewness statistics that are used to check with the symmetry of a probability distribution were also in most cases close to zero. In other words, all series except PSTAR were approximately normally distributed. However, the distribution of PSTAR might be skewed to the right because the mean value was greater than the median, the kurtosis statistic was greater than 3, and the skewness statistic was noticeably different from zero and appeared to be positive.

Following Barro (1991), Figure 3 plots real GDP growth, net of the value predicted by all model variables except the imports/GDP ratio, versus the imports/GDP ratio. That is, the figure shows the partial correlation between real output growth and trade openness. The relationship is strongly negative with the correlation coefficient of -0.74. This partial correlation is conceptually different from a simple correlation coefficient of -0.82. More specifically, real GDP growth is first allowed to be explained by a set of model variables that includes YSTAR, PSTAR, M1, and G; the predicted values of real GDP growth over time are then subtracted from actual values; after that, their differences are plotted in Figure 3 against changes in the imports/GDP ratio. Thus, the results indicate that, holding a set of other variables constant, higher degree of trade openness is substantially negatively related to real GDP growth. Although this simple methodology is different from VAR techniques, the negative association found here approximates the basic results to be discussed below.

III. Basic Results

The sources of changes in the growth rates of output and of the price level are examined through the computation of variance decompositions (VDCs) and impulse response functions (IRFs) which are based on the moving-average representations of the VAR model. The VDCs show the percentages of the forecast error variance for each variable that may be attributed to its own innovation and to fluctuations in other system variables as well. The IRFs further indicate the signs of the effect, whether positive or negative, over time. Since model variables are converted to first differences prior to estimation of the model, the VDCs and IRFs reported here indicate the effects of a shock to a change in openness on the growth rates of output and of the price level.

However, the VAR shocks will be biased and misleading if relevant variables are omitted from the model (e.g., Stock and Watson, 2001). To avoid the 'omitted variable bias', the VAR model is constructed based upon structural assumptions and institutional details. For example, monetary and fiscal policy variables can be potentially correlated (i.e. a debt monetization), and hence macroeconomic effects due to changes in government spending may be incorrectly attributed to money supply if government spending is omitted from the model. In addition, openness can be treated as endogenous and thus it is reasonably assumed to change slowly with foreign shock variables. Based upon a typical policy reaction function, domestic policy variables are also allowed to change with the past values of macro variables.

Reporting VDCs and IRFs without standard errors is similar to reporting regression coefficients without t-statistics, and hence a Monte Carlo integration procedure is employed to estimate standard errors for the VDCs and IRFs (e.g., Runkle, 1987). One thousand draws are employed in the Monte Carlo procedure. For the VDCs, estimates of the proportion of forecast error variance explained by each variable are judged to be significant if the estimate is at least twice the estimated standard error. For the IRFs, a two standard deviation band is constructed around point estimates. If this band includes zero, the effect is considered insignificant.

Since the equations of the VAR contain only lagged values of the system variables, it is assumed that the residuals of the VAR model are purged of the effects of past economic activity. Any contemporaneous relations among the variables are reflected in the correlation of residuals across equations. In this paper, the Choleski decomposition is used to orthogonalize the variance-covariance matrix. In this approach, the variables are ordered in a particular fashion, and, in this way, some structure is imposed in computation of the VDCs and IRFs. If a variable higher in the order changes, variables lower in the order are assumed to change. The extent of the changes depends upon the covariance of the variables higher in the order with that lower in the order.[6]

The variables are ordered as: YSTAR, PSTAR, OPEN, M, G, Y, P. Noting the potential sensitivity of the results to variable orderings, theoretical considerations are employed (e.g., Bernanke, 1986). The placement of foreign output and price shocks first is based on the assumption that South Korea is characterized as a small open economy so that current-period shocks to foreign output and foreign prices are allowed to influence domestic variables, but the domestic economy cannot contemporaneously affect foreign shock variables. The placement of three domestic policy variables (OPEN, M, G) next is consistent with the familiar textbook treatment of aggregate supply and aggregate demand in which current period shocks to the policy variables can affect macroeconomic activities (Y and P) contemporaneously. Assumed in this ordering is that current period shocks to Y and P have no contemporaneous effects on the three policy variables. This is also consistent with the typical policy reaction functions in which the current values of the policy variables depend only on the lagged values of domestic macro variables. Finally, the placement of Y and P last allows the domestic output and prices to respond directly and indirectly to contemporaneous shocks to domestic policy variables, as well as foreign shock variables.

The VAR order is set to twelve quarters to reduce serial correlation of the residuals. The marginal significance levels of the Ljung-Box Q statistics range between 0.67 and 0.99. Choice of other lag lengths merely reduces the significance levels of the Q statistics.[7]

Figure 4 shows the point estimates of the IRFs, which are plotted with a dotted line, while the solid lines represent a two standard deviation band around the point estimates. If this band excludes zero, the effect is considered to be significant. The output effects of YSTAR and PSTAR innovations simply fluctuate around zero over horizons, while their price effects are observed to be positive and significant at short horizons. In the case of a shock to OPEN, the output effect initially rises and then quickly becomes *negative*. The negative effect is significant at horizon of four quarters, and a marginal significance is also observed at eight-quarter horizon. In the longer run, however, the effects are not significantly different from zero. The price effect of OPEN also appears to be initially *negative* and significant, and the significant negative effects are again observed at horizons of five, nine, and thirteen quarters, although some effects are found positive at short horizons.

The significant, negative output effects of a shock to openness do not appear to support the new growth theories that increasing openness helps the domestic economy to grow. The results also appear to be at odds with the findings in Lee (1995) and Kim (2000) for the Korean economy since the short-run negative effects are in the opposite direction of those found in these studies. However, the results are in general consistent with the findings in O'Rourke (2000) for industrialized countries in the late 19th century even though his methodology differs from that used here. One explanation for the negative effects on output growth has been suggested by Aitken and Harrison (1999) based on *a priori* argument of Levine and Renelt (1992). The argument is that trade liberalization of a developing country whose economic fundamentals are not strong enough to compete with foreign investment may discourage domestic investment due to increased international competition, and its decrease in domestic investment would be greater than an increase in foreign investment from abroad. In this case, net investment falls.

On the other hand, the observed negative price effects of a shock to openness are consistent with the findings in Romer (1993), Lane (1997), and Terra (1998), in which inflation falls due to increased openness. The results also appear to be consistent with the aggregate demand channel discussed above: a decrease in net investment due to increased openness reduces aggregate demand, and hence both real output and the price level fall.

Other domestic policy variables (M and G) also have non-trivial effects on economic growth and inflation. Therefore, it is of interest to determine the relative importance of changes in openness to other variable shocks. This information can be obtained by computing variance decompositions (VDCs) of Y and P explained by other system variables.

Table 2 reports the VDC results. The estimated standard errors are in parentheses. A * indicates that point estimates are at least twice the standard errors--our rule of thumb for judging significance. VDCs at horizons of 4, 8, 12, 16, 20 quarters are shown in order to convey a sense of the dynamics of the system. Only the effects on Y and P are shown in Table 2 to conserve space and focus upon the variables of central interest to this paper. The forecast error variance of Y explained by OPEN innovation appears to be significant at short horizons, and the effect of openness is greater than the effects of other variable shocks. The price effects of shock to openness are also greater than the effects of other variable shocks, and the effects are significant at all horizons. The results are generally consistent with the IRF results found in Figure 4. Furthermore, the price effects of YSTAR innovations are relatively large and appear to be significant at all horizons. Shocks to M and G also appear to be significant over longer horizons. The shocks emanating from domestic policy variables such as M and G, as well as foreign output shocks YSTAR, may transmit to the domestic economy through the aggregate demand channel in which real output and prices are affected by an increase in aggregate demand. However, the results that price effects are greater than real output effects suggest that an aggregate supply curve is relatively steep in Korea.

IV. Alternative Specifications and Sensitivity Results

A. Lag Lengths

It is a common practice to choose an *ad hoc* lag length when specifying a distributed-lag time series model. Because economic theory is often not very explicit about the lag lengths, several VAR orders are employed to check on the robustness of the results.

Table 3 shows the results of the VDCs with common lag lengths: 8, 10, 12, 14, and 16 quarters. The 12-quarter lags employed in Table 2 are used here as a benchmark lag length. Although the sample period begins from 1960:1, estimation begins from 1962:2 1962:4, 1963:2, 1963:4, and 1964:2, respectively, due to the use of different lag lengths. The degrees of freedom reduce by sixteen in each column, and thus the lag length longer than 16 quarters is not used here. The lag length shorter than 8 quarters is not used either, since the serial correlation of residuals appears to be serious with the use of shorter lags. Again, only the effects of OPEN on Y and P are shown to focus upon the variables of central interest to the paper and to conserve space. The forecast error variance of output explained by shocks to openness is small and insignificant for the 8-lag model, while the VDCs with 10-quarter lags are all within one standard deviation of those in the 12-lag model. The results are more convinced when longer lags are used. For 14-quarter and 16-quarter lags, the point estimates are even greater than those in the 12-lag model. A similar pattern is observed for the forecast error variance of prices. For the lags smaller than 12 quarters, the point estimates are relatively small but in most cases significant; but the VDCs are large and significant when longer lags are used. Thus, the significant output and price effects of openness are, with only a few exceptions, qualitatively unchanged.

B. Variable Orderings

Another potential problem of this reduced-form VAR approach is that contemporaneous correlation may exist among the residuals of the VAR model. For example, if the current value of the residuals in the first equation is correlated with the current value of the residuals in the second equation, the variable in the second equation is affected by changes in the variable of the first equation. Thus, a pure innovation in a particular variable lower in order cannot be isolated. For this reason, innovation accounting often uses the Choleski decomposition of the residual variance-covariance matrix to identify orthogonal shocks to each variable. Although the Choleski decomposition orthogonalizes the VAR residuals, it is generally recognized that innovation accounting results of the VAR are potentially sensitive to the ordering of system variables. Specifically, if there is a substantial contemporaneous correlation among system variables, variable ordering matters. If a variable higher in order changes, the variable lower in order also changes. Consequently, innovation accounting results may be potentially sensitive to the ordering of variables.

The orderings chosen for study are the following: (1) YSTAR, PSTAR, OPEN, M, G, Y, P; (2) YSTAR, PSTAR, M, G, OPEN, Y, P; (3) OPEN, YSTAR, PSTAR, M, G, Y, P; (4) YSTAR, OPEN, PSTAR, M, G, Y, P; and (5) YSTAR, PSTAR, OPEN, M, G, P, Y. As noted earlier, the benchmark ordering (1) is designed to be consistent with a model in which the IS-LM model underlies aggregate demand and where output and the price level respond to current innovations in domestic policy variables as well as foreign shock variables. In ordering (2), OPEN is allowed to be affected by contemporaneous shocks to M and G. This is the case that monetary and fiscal policy shocks may cause large foreign exchange depreciation; the depreciation would increase exports but decrease imports; and thus the imports/GDP ratio, which is our openness measure, would be affected by monetary and fiscal policy. Furthermore, this ordering is consistent with the set of structural models in which foreign shocks as well as domestic policy variable shocks have both direct and indirect contemporaneous effects on OPEN. Ordering (3), however, places OPEN first, based on the assumption that any contemporaneous effects flow from the openness variable to all other model variables. Ordering

(4) places the openness variable next to YSTAR but prior to PSTAR. Ordering (5) is the same as ordering (1) except that Y and P are switched.

The VDCs for all different orderings are reported in Table 4. Although OPEN is placed in different locations, the results are qualitatively unchanged. The point estimates found in orderings (2) - (5) are all within one standard deviation of those in column (1). Even if the openness variable is placed at the bottom of the policy variables as in ordering (2), the price effects are almost the same as before. Although small variations are observed in output effects, the changes are within one standard deviation of the VDCs. Another extreme case is the ordering (3) that places the openness variable on the top of the variables, but the VDCs are, again, changed little over time. For the rest of alternative orderings, similar results are observed. Note that, for ordering (5), the point estimates are identical to those in column (1) since the order of OPEN is unchanged. The VDCs, thus, indicate that significant effects of openness on the macroeconomy are not materially changed although different orderings have been used.

C. Openness Measures

Table 5 further reports the VDC results, employing alternative openness measures. In addition to the imports/GDP ratio that was used for the basic results, the second column employs the (exports + imports)/GDP ratio that reveals the degree of a country's openness to world trade: the more open to international trade, the less is the restriction in both exports and imports, and hence the trade share in GDP will be greater. The VDC results in the second column appear to be similar to our earlier findings, even with greater VDCs than in the first column.

The next two columns show the results when two proxies for financial market openness are used. As indicated in Levine and Renelt (1992), openness and growth relations may occur through investment and hence increasing openness may raise long-run growth only insofar as openness provides greater access to investment goods. When countries begin to liberalize in financial markets, foreign direct investment (FDI) will be stimulated from abroad. Thus, the FDI/GDP ratio is used as a proxy for financial market openness in the third column. The last column further employs interest rate differentials in which a large (small) gap between domestic and foreign interest rates may represent a relatively closed (open) economy. For these two measures, our sample begins in 1977:1 since this is the earliest date for which we can obtain the FDI series, as well as market interest rates. The beginning of our sample roughly coincides with the period in which the Korean government placed increased reliance on FDI and the sale of bonds to foreign investors. Ideally, a debt series that is held by foreigners as a percentage of total debt would also be preferred, but no series of this type is available quarterly. Because sample periods are relatively short, eight lags are used rather than twelve. It is observed that the size of the output and price effects in the third column are very close to the benchmark effects, with small changes that are all within one standard deviation of those in the first column. However, the two effects in the last column particularly shrink. The output effects are found small and insignificant, while the price effects are marginally significant.

Furthermore, the IRF results are presented in Figure 5. Again, the significant short-run effects of financial market openness, in general, appear to be *negative* on the growth rates of output and of the price level. First, the shocks to the FDI/GDP ratio have negative and significant effects on both output and prices in the short horizons. The longer-run effects are however close to zero. Second, the interest rate differentials also have negative and significant impacts on prices although the output effects are marginally significant. In addition, two measures of trade openness are observed to have significant *negative* effects on Y and P in the short run. One exception is the insignificant response of P to shocks to the imports/GDP ratio. The results found here are slightly different from those in Figure 4, because here in Figure 5 eight lags are used rather than twelve to be consistent with others. Other than that, the significant short-run effects are all *negative*.

V. Concluding Remarks

This paper has examined the effects of increasing openness on the growth rates of output and of the price level in Korea. Unlike most studies that have concentrated on the estimation of cross-country or cross-industry averages, this study focuses upon the dynamics of openness-growth and openness-inflation relations for a rapidly growing economy, one in which rapid growth has been accompanied by a persistent government intervention in international trade and financial markets. This study also differs from others in the literature by employing VAR techniques that are of a less restrictive empirical framework. The framework of analysis is a seven-variable VAR model that consists of real output, the price level, the money supply, real government spending, foreign output shock, foreign price shock, and openness measures.

The effects of changes in openness on economic growth and inflation rates are evaluated through the computation of impulse response functions and variance decompositions. The impulse response functions indicate that significant effects of a shock to openness on the growth rates of output and of the price level are *negative*. The variance decompositions also indicate that the effects of openness shock on these variables are significant and even greater than the effects of other variable shocks. The results are, in general, robust across lag lengths, variable orderings, and alternative openness measures. The impulse response functions further indicate that proxies for financial market openness, as well as trade openness, have *negative* impacts on the growth rates of output and of the price level.

In the new growth theories, increasing openness has a positive effect on economic growth. In the short run, output is affected *negatively* by openness measures although no longer-run effects. The results thus do not appear to support the new growth theories, since the short-run negative effects are in the opposite direction of those predicted by the new growth theories. The price effect of openness is also found *negative*. The significant negative effects of increasing openness on output growth and inflation appear to be consistent with the argument of Aitken and Harrison (1999) and Levine and Renelt (1992) that the increased international competition due to openness may cause domestic investment to shrink and its reduction would be greater than an increase in capital inflows. In this case, net investment falls, and thus output and the price level may also fall. Finally, we stress that the domestic economy will also suffer a loss if financial markets are not strong enough to compete with foreign investment but suddenly open to the world; Korea’s financial crisis of 1997 is one.

FOOTNOTES

1. Here, tariffs are assumed to be reduced on final goods, not on intermediate inputs. Suppose tariffs are reduced on intermediate inputs, then the tariff cut reduces import prices, which, in turn, reduce costs of production to boost output. This type of effect would raise aggregate supply.
2. Unlike the study for the late 19^{th} century, Edwards (1992, 1993, 1998), Lee (1993, 1995), Sachs and Warner (1995), Sala-i-Martin (1997), and Kim (2000), among others, found that tariff rates had negative effects on the rate of growth for the late 20^{th} century.
3. An anonymous referee also indicated this point how much the imports/GDP ratio in time series is associated with changes in openness; thanks for the comment.
4. The drawback, of course, is that it is difficult to distinguish sharply among different structural models, since the VAR technique used here is a reduced-form approach. Cooley and LeRoy (1985) and Leamer (1985) had pointed out this limitation of the VAR approach. Recently, Stock and Watson (2001), among others, critically argued that structural VAR models were also difficult to use for structural inferences and policy analyses, since the results of the structural VARs were found sensitive to the specific identifying assumptions used. Therefore, the standard VAR approach can provide sensible estimates of some causal inferences as long as the VAR models are specified based on structural assumptions and institutional details,
5. The results are not reported here to conserve space, but are available upon request.
6. Several alternatives to the Choleski decomposition have been suggested. Bernanke (1986) uses the residuals from a structural model as 'fundamental' shocks, and Blanchard and Quah (1989) use long-run constraints that are, in principle, consistent with alternative structural

models as fundamental shocks. However, unless the structural models are just identified, in general, there will be correlation across equations in the residuals of the structural model, and the issue of an appropriate ordering arises again.

7. Akaike and Schwarz criteria selected too many lags for optimum, so that the degrees of freedom were quickly depleted. Alternatively, several common lags were employed in section V to check on the robustness of the results across the lag lengths.

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Table 1. Descriptive Statistics: 1961:1-1997:3

	YSTAR	*PSTAR*	*IMP/GDP*	*M1*	*G*	*GDP*	*GDP deflator*
Mean	0.0334	0.0341	0.0060	0.1994	0.0943	0.0827	0.1212
Median	0.0376	0.0117	0.0081	0.1836	0.1060	0.0787	0.1258
StandDev	0.0390	0.1272	0.0438	0.1145	0.1862	0.0471	0.0832
Kurtosis	1.7595	4.0309	1.0950	-0.2834	2.5400	0.7097	0.2971
Skewness	-0.9521	1.5118	-0.4859	0.1069	-0.5442	-0.2249	0.3949
Min	-0.1166	-0.2017	-0.1646	-0.0742	-0.7027	-0.0687	-0.0590
Max	0.1027	0.5959	0.1017	0.5246	0.6602	0.2183	0.3683
Obs	147	147	147	147	147	147	147

Note: all variables are in log differences ($\ln X_t - \ln X_{t-4}$), except for the imports/GDP ratio that is not taken logarithm but first differences.

Table 2. Variance Decompositions: Basic Results

Variables explained	Horizon (quarter)	Explained by shocks to						
		YSTAR	PSTAR	OPEN	M	G	Y	P
Y	4	2.8(2.7)	5.3(3.7)	9.2(4.2)*	3.0(2.3)	2.2(2.5)	73.7(6.3)	3.8(3.1)
	8	3.2(2.8)	5.0(3.6)	11.0(4.9)*	3.1(2.5)	3.2(3.3)	56.6(7.0)	18.1(5.9)
	12	5.1(3.6)	4.4(3.7)	9.9(4.9)*	5.4(4.1)	5.2(4.1)	50.7(7.5)	19.3(6.5)
	16	5.9(3.8)	5.0(4.0)	8.7(4.9)	6.1(5.0)	8.8(5.2)	45.3(8.1)	20.1(6.7)
	20	5.2(3.7)	6.6(4.5)	7.7(4.7)	8.9(6.4)	9.9(5.7)	41.0(8.5)	20.8(6.9)
P	4	8.4(4.1)*	5.3(3.4)	11.8(4.3)*	3.8(2.7)	5.8(3.5)	7.2(2.9)	57.7(5.9)
	8	10.0(4.6)*	5.9(3.0)	14.5(5.0)*	9.3(4.6)*	4.5(3.0)	8.9(3.3)	46.9(5.7)
	12	15.4(5.4)*	5.4(3.0)	18.1(5.4)*	8.8(3.9)*	5.7(3.0)	9.2(3.6)	37.5(5.1)
	16	15.3(5.1)*	5.0(3.0)	21.6(5.9)*	7.9(3.6)*	6.9(3.1)*	9.2(3.5)	34.0(4.8)
	20	14.6(4.8)*	5.3(3.1)	20.6(5.6)*	9.3(4.1)*	7.4(3.2)*	10.7(3.8)	32.1(4.8)

Note: The numbers in parentheses represent standard errors estimated by using a Monte Carlo integration procedure. The point estimates are significant if the estimate is at least twice the standard error.

Table 3. Variance Decompositions: Alternative Lag Lengths

Variables explained	Horizon (quarter)	Explained by shocks to OPEN				
		8 lags	10 lags	12 lags	14 lags	16 lags
Y	4	2.1	5.6	9.2(4.2)	11.9	10.1
	8	1.8	6.6	11.0(4.9)	16.1	23.9
	12	2.2	6.7	9.9(4.9)	15.2	30.6
	16	2.2	6.6	8.7(4.9)	13.3	29.0
	20	2.2	6.3	7.7(4.7)	12.9	28.1
P	4	9.5	10.9	11.8(4.3)	14.0	10.9
	8	11.4	12.4	14.5(5.0)	26.1	23.9
	12	11.2	14.2	18.1(5.4)	31.2	28.6
	16	10.6	15.4	21.6(5.9)	35.8	32.1
	20	10.3	15.9	20.6(5.6)	35.3	34.8

Note: see Table 2.

Table 4. Variance Decompositions: Alternative Variable Orderings

Varibles explained	Horizon (quarter)	Explained by shocks to OPEN				
		(1)	(2)	(3)	(4)	(5)
Y	4	9.2(4.2)	7.5	9.4	9.7	9.2
	8	11.0(4.9)	8.1	11.2	11.4	11.0
	12	9.9(4.9)	6.8	10.0	10.2	9.9
	16	8.7(4.9)	5.9	8.8	9.0	8.7
	20	7.7(4.7)	5.3	7.7	7.9	7.7
P	4	11.8(4.3)	10.2	12.5	12.3	11.8
	8	14.5(5.0)	12.2	15.2	14.7	14.5
	12	18.1(5.4)	17.7	19.0	18.3	18.1
	16	21.6(5.9)	21.9	22.4	21.8	21.6
	20	20.6(5.6)	20.6	21.4	20.9	20.6

Note: see Table 2. Variable orderings are in the following order: (1) YSTAR, PSTAR, OPEN, M, G, Y, P; (2) YSTAR, PSTAR, M, G, OPEN, Y, P; (3) OPEN, YSTAR, PSTAR, M, G, Y, P; (4) YSTAR, OPEN, PSTAR, M, G, Y, P; and (5) YSTAR, PSTAR, OPEN, M, G, P, Y.

Table 5. Variance Decompositions: Alternative Openness Measures

Variables explained	Horizon (quarter)	Explained by shocks to			
		Imports/GDP	Trade/GDP	FDI/GDP	r^*/r
Y	4	9.2(4.2)	6.9	1.9	6.0
	8	11.0(4.9)	10.5	11.6	6.9
	12	9.9(4.9)	12.1	11.5	6.8
	16	8.7(4.9)	11.3	10.6	6.7
	20	7.7(4.7)	9.8	9.3	6.6
P	4	11.8(4.3)	15.4	17.7	7.7
	8	14.5(5.0)	19.1	18.7	11.4
	12	18.1(5.4)	26.7	19.1	11.6
	16	21.6(5.9)	33.7	19.4	11.9
	20	20.6(5.6)	33.4	19.7	11.5

Note: see Table 2.

Figure 1. Imports/GDP Ratio, 1960:1-1997:3

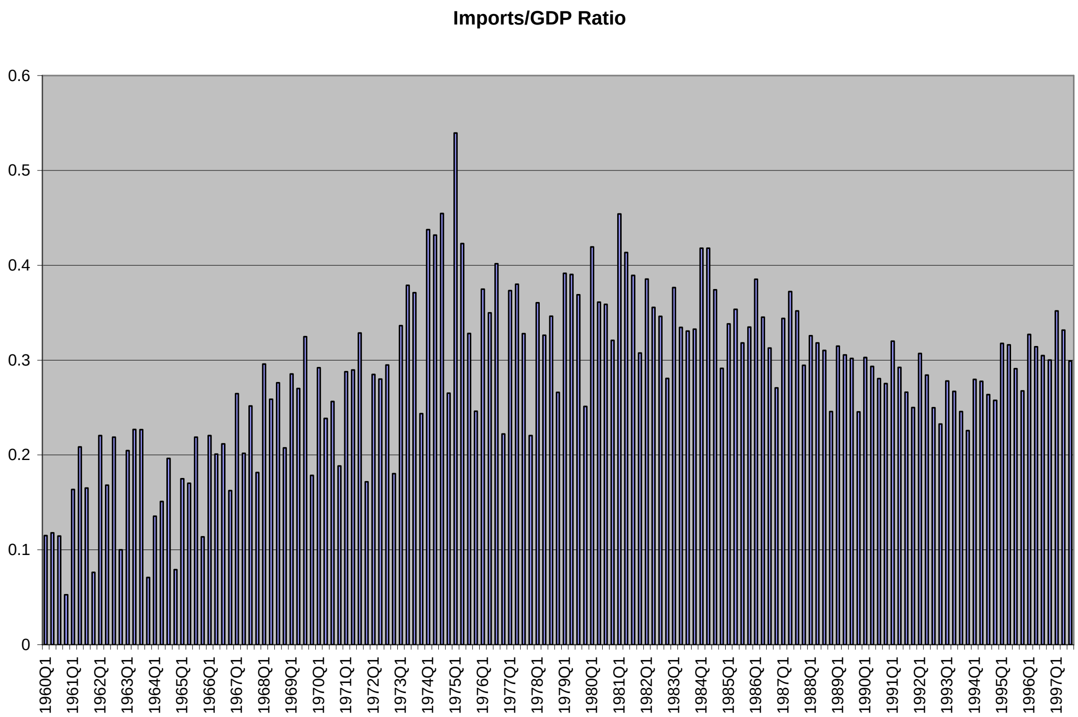
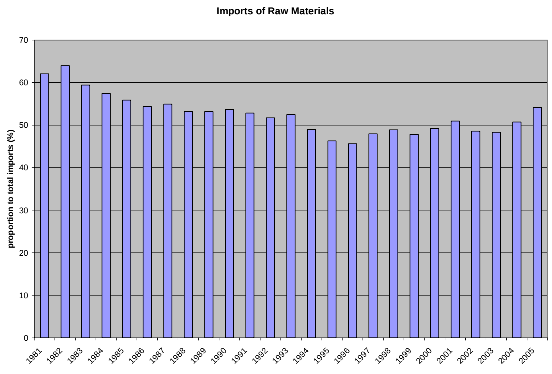


Figure 2. Imports of Goods by Commodity Types, 1981-2005



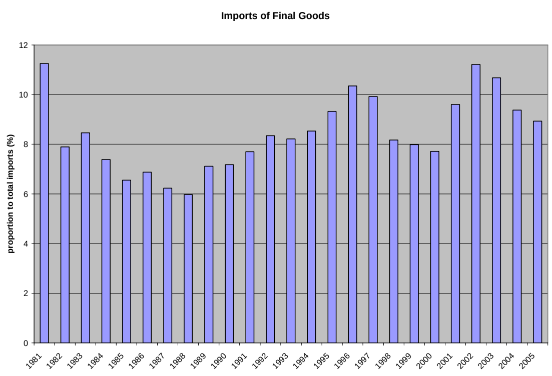


Figure 3. Partial Association between Real GDP Growth and Imports/GDP Ratio

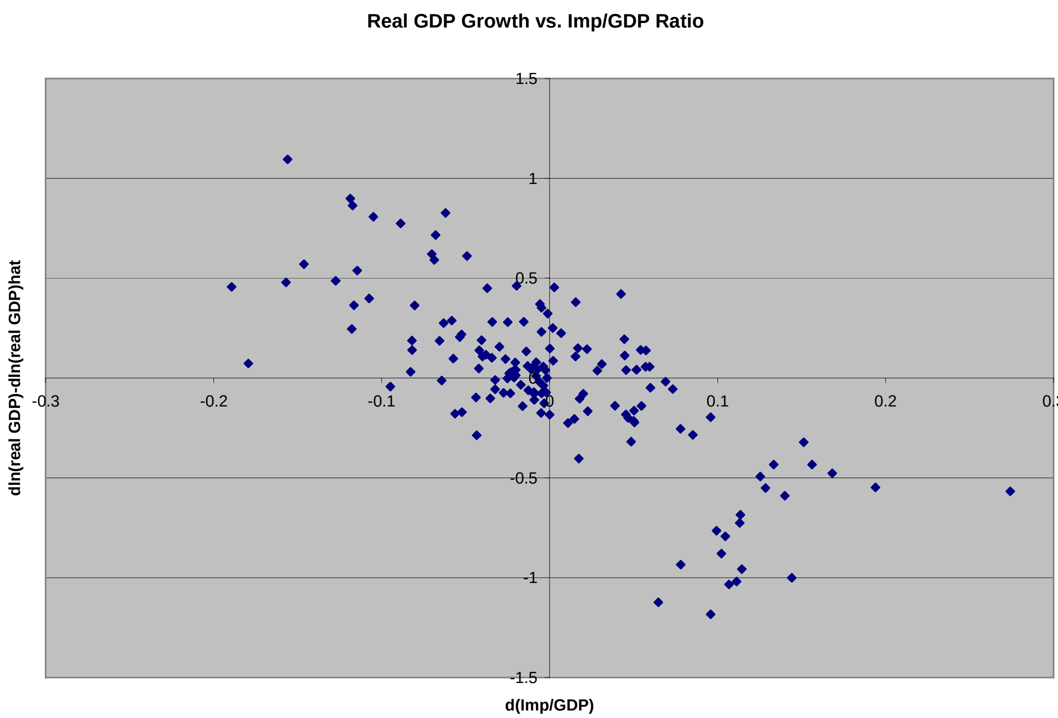


Figure 4. Impulse Responses: Basic Results

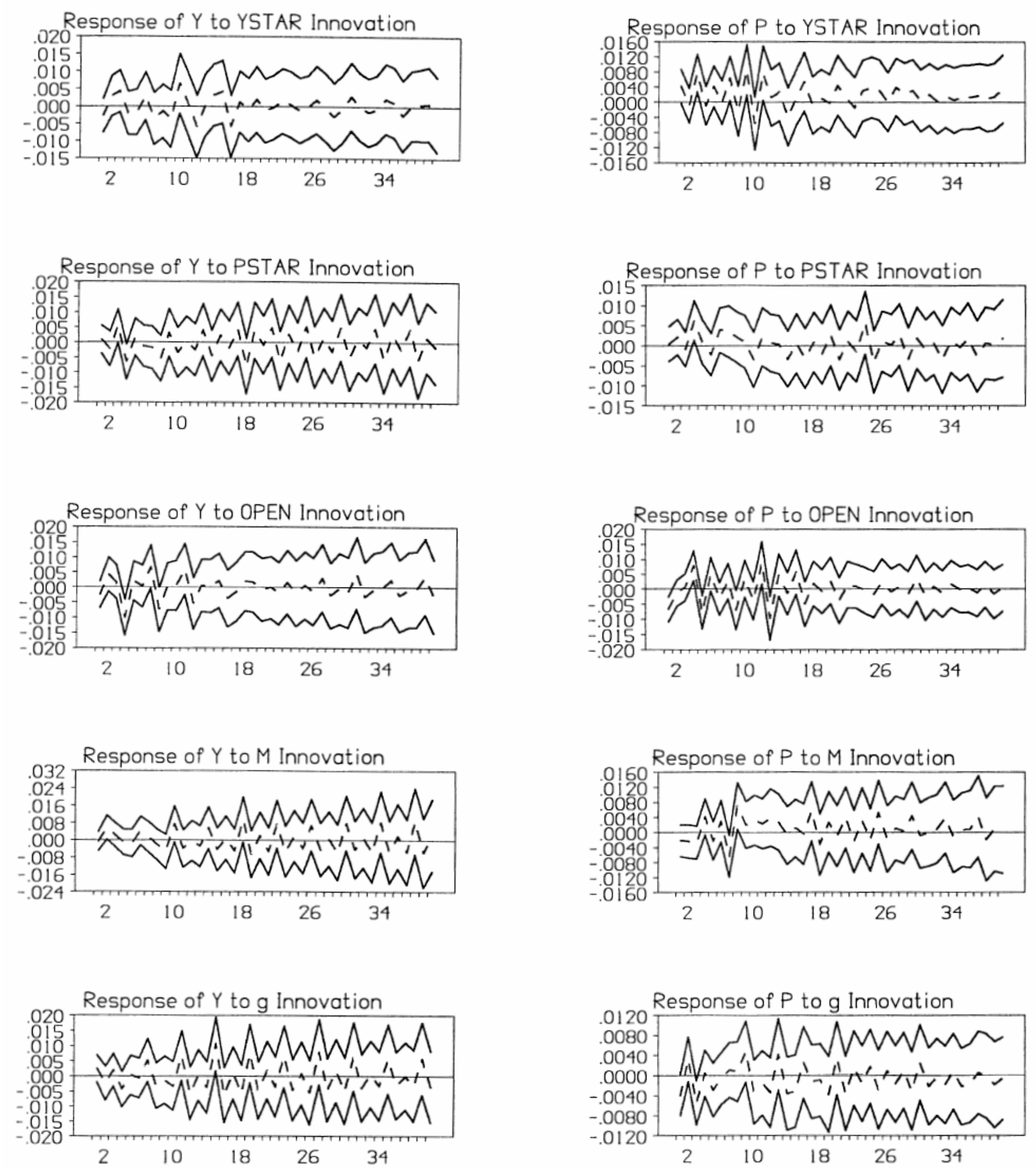


Figure 5. Impulse Responses: Alternative Openness Measures