The Influence of Foreign Capital on the Korean Stock Exchange

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From 1992 Korea's financial markets have been liberalised in two distinct steps to open up, particularly, the stock market to international capital. There have been criticisms that such liberalisation invites destabilising forces. In this paper we investigate the trading behaviour of foreign investors. First we examine the links between internal returns and trading in order to identify causality in the Granger sense. We then set up hypotheses and test in order to attempt to distinguish between "informational" and "noise" trading behaviour. Surprisingly, both hypotheses are rejected. Therefore, and finally, we test behavioural hypotheses with regard to expectations incorporating exchange rate movements. The two hypotheses relate to what we term "follower" and "predictor" behaviour. The results can be interpreted as noise type behaviour in relation to exchange rates leading to increased volatility in stock markets.

1. INTRODUCTION

This paper leans heavily upon the work of Sellin (1996) who examined the effects on Swedish stock market prices of increased foreign activity following the lifting of restrictions on foreign ownership of Swedish stocks in 1993. Sections 2 and 3 largely replicate Sellin's analysis using

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Korean data sets, but we test further hypotheses in Section 4. In January 1992 restrictions on portfolio investment in Korea by foreigners were partially lifted, allowing up to 10% ownership of individual stocks for aggregate foreign investment and 3% for individual foreign investment. This liberalisation was carried further, when, in December 1997, the investment ceilings were raised to 55% for aggregate foreign investment and to 50% for individual foreign investment. The presence of foreign investors in the Korean stock market has increased as a result.

The paper analyses foreign investor trading behaviour in the Korean Stock Market. The purpose is to investigate: 1) whether foreign investors behave in a myopic fashion or whether they trade on the basis of information about fundamentals (noise v informational trading, respectively); 2) whether international trading creates excess volatility in the Korean Stock Market; and 3) whether foreign investors react to changes in the exchange rate or anticipate exchange rate movements.

The plan of the paper is as follows: the data description, unit root test results and Granger causality tests to establish the direction of causality between trading and returns are presented in Section 2. In Section 3 we formally test the informational trading hypothesis versus the noise trading hypothesis. In Section 4 we test two further behavioural hypotheses, which we term exchange rate "follower" and exchange rate "predictor" hypotheses. Section 5 concludes.

2. UNIT ROOT AND DESCRIPTIVE STATISTICS

The data set comprises of foreign purchases and sales of Korean stocks as received by the Korea Stock Exchange on a monthly basis. Our study is confined to the initial period of liberalization, i.e. January 1992 to December 1997. Figures 1 and 2 show foreign purchases (p_t) and sales (s_t), respectively, of Korean equity. Purchases have clearly increased over the period (annual totals would show a clear rising trend) with peaks at mid-year in 1995, 1996 and 1997. Figure 2 shows an even clearer rising trend in sales of stocks. The value of foreign trading in stocks has increased by several orders of magnititude since 1992.

Figure 1 Foreign Purchase of Korean Stocks
(Monthly Totals, billion Won)
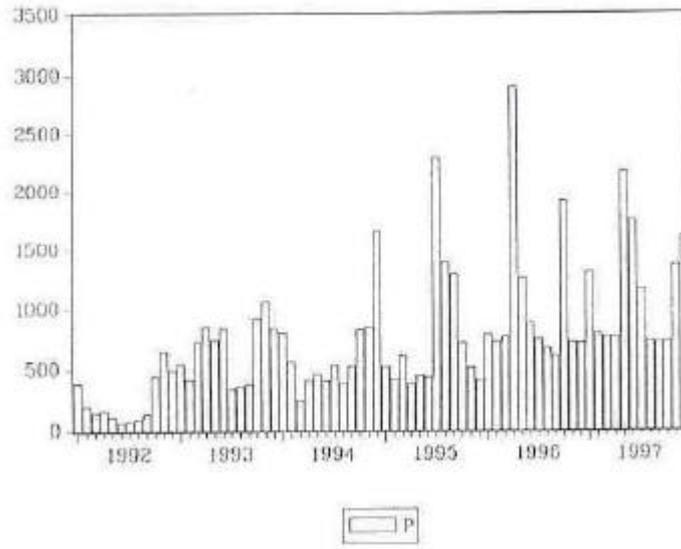
Figure 2 Foreign Sales of Korean Stocks
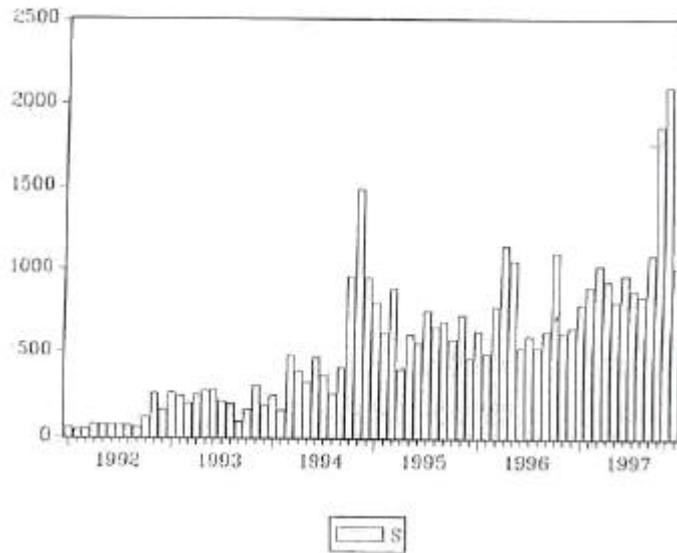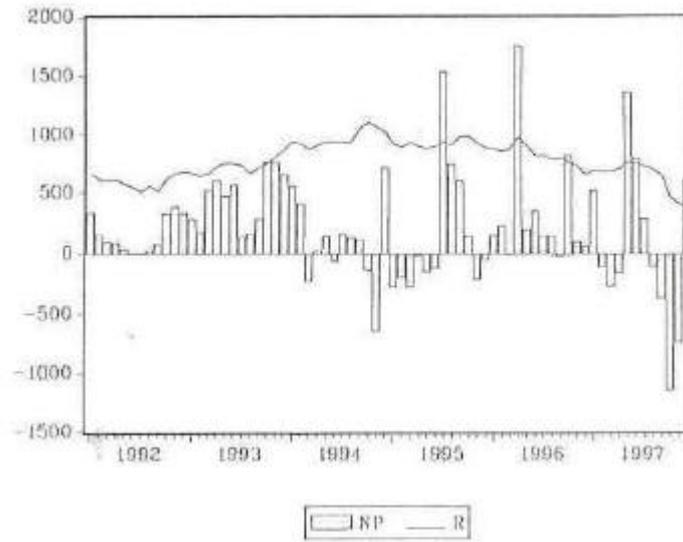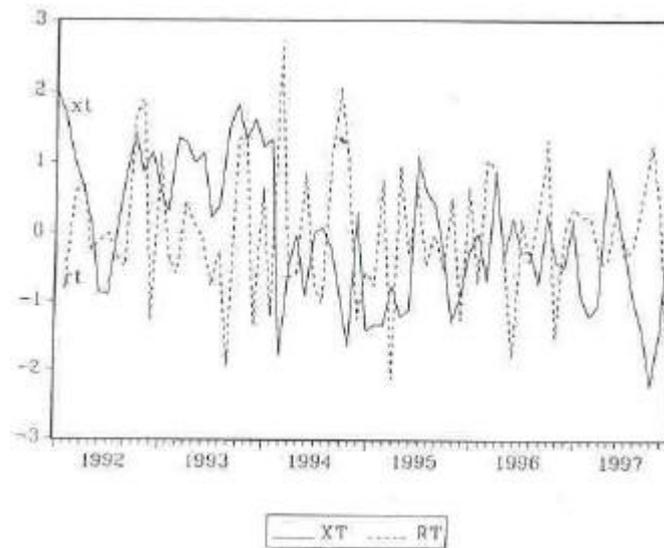**(Monthly Totals, billion Won)**

Figure 3 Net Purchase and Returns (billion Won)

Figure 4 Returns and Net Purchase Divided by Turnover

Net purchases ($N_t=P_t-S_t$) are shown in Figure 3 along with a representation of the Korean Stock Exchange (price) Index (I_t). Net purchases of foreign investors peaked during 1993 (4,330.3 billion won), mid-1995 (1,361.2 billion won) and early-1996 (3,147.2 billion won). However, they sharply decreased from mid-1997due to the financial crises in Korea. Since net purchases are clearly not stationary, following Sellin, we compute relative net purchases, that is the ratio of net purchases to total foreign turnover, $x_t=(P_t-S_t)/(P_t+S_t)$. In Figure 4 we show the return to foreign investors: monthly returns on stocks ($r_t=\log(I_t/I_{t-1})$) are plotted along with the ratio of net purchases to turnover.

The average monthly return for the period was about 2% and foreign investors were net buyers in the market.

As the Granger tests require stationarity in the variables, we tested for stationarity and the order of integration of the variables. More specifically, we tested whether the stock prices are integrated of order zero, $I(0)$. That is, whether the variables (r_t, x_t, p_t, and s_t) are stationary. This was achieved by performing the Dickey-Fuller (DF) and the agumented Dickey-Fuller (ADF) tests, based on the standard regression with a constant and a time trend. The results are reported in Table 1.

The results clearly show that all the variables are stationary in the series. But the results of the ADF test show that the serial correlation in the disturbance term has a significant effect on the power of the test statistics. Therefore, the null hypothesis cannot be rejected for purchase and sales variables.

Table 1 Unit Root Test Results

	x	p	S	r
DF	-3.48[b]	-3.51[b]	-3.52[b]	-5.24[a]
ADF	-2.13[b]	-0.37	-0.97	-4.66[a]

Note: 1) a: statistical significance at the 1% level.
     2) b: statistical significance at the 5% level.

On the basis of the results, we now determine the direction of

causality between trading and returns as a preliminary step in our analysis. We use the concept of Granger causality. The variable z_t is said not to "Granger cause" y_t, if the lagged variables z_{t-i}, $i=1, ..., m$ have no explanatory power in the following regression.

$$y_t = c + \sum_{i=1}^{m} a_i\, y_{t-i} + \sum_{i=1}^{m} b_i Z_{t-i} + e_t \,. \qquad (1)$$

Hence, if the restriction $b_i=0$, $i=1, …, m$ is rejected, we say that z_t Granger causes y_t. Before we consider whether trading causes returns or not, we want to make sure that causality does not run in the reverse direction. We thus check if returns cause trading using the Granger regression.

$$x_t = c + \sum_{i=1}^{m} a_i\, x_{t-i} + \sum_{i=1}^{m} b_i r_{t-i} + e_t \,. \qquad (2)$$

To check for the possibility of asymmetry in the relationship between purchases and sales we also use p_t and s_t instead of x_t in the regression above.

Table 2 Granger Causality Tests

1) Do returns cause trading ?

Dependent Variable	Independent Variable	F-Test
X_t	r_{t-i}	0.4321 (0.7307)
P_t	r_{t-i}	0.6121 (0.7431)
S_t	r_{t-i}	0.2674 (0.7662)

2) Does trading cause returns ?

Dependent Variable	Independent variables	F-Test
r_t	X_{t-i}	3.1030 (0.3381)
r_t	P_{t-i}	3.0559 (0.3539)
r_t	S_{t-i}	3.7152 (0.1881)

The test results are reported in Table 2. The Akaike's information criterion chose two lags in all cases. The probability values for the F-tests with regard to net purchases, purchases, and sales are greater than 0.7. Hence, we cannot reject the hypothesis that returns do not cause trading results. The reverse causality tests are also reported in (2) of Table 2. We reject the hypothesis that trading does not cause returns at the chosen significance level in all cases. Thus, causality seems to run in the direction predicted by both the informational trading and the noise trading hypotheses. So far, this is agreement with Sellin's results.

3. INFORMATIONAL TRADING OR NOISE TRADING

Here we consider in detail the two contrasting ways of characterizing the average trading behaviour of international investors: informational trading and noise trading. Informational trading is the traditional way of thinking about trading in financial economics. The reason for agents to trade is the arrival of new information. According to conventional financial theory, all new publicly available information is rapidly impounded in securities prices through trading by informed investors. Securities markets are said to be informationally efficient, or semi strong-form efficient. Noise trading is trading that is not based on information about fundamentals. There is considerable evidence that many investors do not follow advice based on real signals to buy and hold the market portfolio. Black (1986) believes that such investors, with no access to inside information, irrationally act on noise as if it were information that would give them an edge. Following Kyle (1985), Black calls such investors "noise traders". In order to be able to distinguish between the informational trading hypothesis and the noise trading hypothesis, we have tested the model in equation (3).

$$r_t = c + a_1 r_{t-1} + a_2 r_{t-2} + b_0 Z_t + b_1 Z_{t-1} + b_2 Z_{t-2} + e_t. \qquad (3)$$

According to the informational trading hypothesis, returns should not

Table 3 Information Trading or Noise Trading

	$Z_t=X_t$	$Z_t=P_t$	$Z_t=S_t$
C	0.05 (0.89) [3.61]	0.08 (0.60) [1.72]	0.01 (0.04) [1.90]
a_1	-0.23 (-1.83) [1.82]	-0.23 (-1.84) [0.33]	-0.22 (-1.80) [2.30]
a_2	-0.16 (-1.36) [-0.56]	-0.15 (-1.26) [-0.85]	-0.17 (-1.43) [-0.12]
b_0	-0.53 (-2.61) [-0.59]	-0.61 (-2.82) [1.75]	0.38 (2.48) [1.08]
b_1	0.52 (2.15) [0.60]	0.49 (1.88) [-0.27]	-0.50 (-2.70) [-0.37]
b_2	0.05 (0.26) [-0.50]	0.15 (0.66) [-0.46]	0.06 (0.37) [-0.28]
$Q(9)$	6.50	7.05	6.13
R^2_{adj}	0.20	0.15	0.15
D.W.	2.05	2.05	2.05
Info. Trading: H_0: $b > 0$	3.88	3.87	4.62
Noise Trading: H_0: $Y = \ln(L_1 + sL_1)$	3.07	3.43	10.44

Note: 1) t-statistics are in parentheses and White t-statistics are in brackets.
   2) $Q(9)$ is the Ljung-Box statistic for serial correlation.
   3) In connection with the F-tests of the hypotheses, probability values are shown in parentheses and probability values based on White's (1980) heteroskedasticity-consistent covariance matrix estimator are in square brackets.

be influenced by traders in previous periods. Therefore, the null hypothesis for informational trading is $b_0 = b_1 = b_2 = 0$.

The noise trading hypothesis is a test of the restrictions $b_0 = b_1 = b_2 = 0$ and $b_0 + b_1 + b_2 = 0$. If the noise trading hypothesis is true, we should reject the first restrictions but not reject the second.

The results are shown in Table 3 for the three model specifications. The last two rows show the F-tests for the information and noise trading hypotheses. Unlike Sellin's results neither hypothesis is supported. These findings are somewhat surprising because they imply that foreign investor behaviour in the Korean market does not accord with either hypothesis. If, therefore, foreign investment is not related to rates of return on the Korean stock market, what does motivate investors? Clearly, anticipated rate of return might be expected to encompass the rate of

return associated with the whole investment transaction, including gains or losses associated with foreign exchange movements. We test this possible relationship in the next section.

4. FURTHER TESTS OF FOREIGN INVESTOR BEHAVIOUR

If foreign investors expect high returns from holdings in Korean Won they are likely to invest in Korean stock, (contributing to upward pressure on stock prices). Recently, stock price movements have appeared to track exchange rate movements in Korea. It is of interest, therefore, to test the relationship of foreign investor behaviour to changes in the exchange rate. Buying or selling behaviour which follows exchange rate movements we call the "follow" hypothesis. The reverse hypothesis is that foreign investors buy or sell in anticipation of exchange rate movements (with some degree of accuracy). This we call the "predictor" hypothesis.

Since American investors are the largest group of foreign investors in the Korean market we base our exchange rate variable on the Won/US Dollar rate.

To test these hypotheses we use VAR (Vector Autoregressive) model with foreign net stock purchases, stock index return and the rate of change in the Won/US Dollar exchange rate (e_t). A VAR is a system of equations that makes each endogenous variable a function of its own past and of the past of the other endogenous variables in the system. Nelson and Schwert (1982) suggest the possibility of basing tests for causality on a parsimoniously parameterized vector ARMA model fitted to the data. This approach is followed by Newbold and Hotopp (1986). Let (x_t, r_t and e_t) be a pair of time series generated by an ARMA (p, q) model. In order to take into account both the direct and indirect interactions among the variables in the system in testing the hypothesis we need to consider the above model, which is given by

$$\begin{bmatrix} a_{11}(B) a_{12}(B) a_{13}(B) \\ a_{21}(B) a_{22}(B) a_{23}(B) \\ a_{31}(B) a_{32}(B) a_{33}(B) \end{bmatrix} \begin{bmatrix} x_t \\ r_t \\ e_t \end{bmatrix} = \begin{bmatrix} b_{11}(B) b_{12}(B) b_{13}(B) \\ b_{21}(B) b_{22}(B) b_{23}(B) \\ b_{31}(B) b_{32}(B) b_{33}(B) \end{bmatrix} \begin{bmatrix} \boldsymbol{h}_{1t} \\ \boldsymbol{h}_{2t} \\ \boldsymbol{h}_{3t} \end{bmatrix} \quad (4)$$

Following Kang (1981), we can re-write as

$$|a(B)| \begin{bmatrix} x_t \\ r_t \\ e_t \end{bmatrix} = d + \begin{bmatrix} b_{11}(B) b_{12}(B) b_{13}(B) \\ b_{21}(B) b_{22}(B) b_{23}(B) \\ b_{31}(B) b_{32}(B) b_{33}(B) \end{bmatrix} \begin{bmatrix} \boldsymbol{h}_{1t} \\ \boldsymbol{h}_{2t} \\ \boldsymbol{h}_{3t} \end{bmatrix} \quad (5)$$

where $|a(B)|$ is the determiant of the $a(B)$ matrix, d is a vector of constants, and the $b(B)$ matrix contains the moving average coefficients that we are interested in using in our tests. We run the following tests:

1) "Follow" hypothesis vs $H_0 : b_{13}(B) = a_{31}(B) + (a_{21}a_{32} - a_{22}a_{31})B^2 = 0$.

2) "Predict" hypothesis vs $H_0 : b_{31}(B) = a_{13}(B) = (a_{12}a_{23} - a_{13}a_{22})B^2 = 0$.

The most direct procedure for testing these hypotheses is through a Wald test. Let $\boldsymbol{b}$ denote the vector of autoregressive and moving average parameters, and $f(\boldsymbol{b})$ the set of constraints on these parameters implied by the hypotheses. Denote by $\hat{\boldsymbol{b}}$ the unconstrained estimators of $\boldsymbol{b}$, obtained through maximum likelihood, and by their estimated covariance matrix. The Wald test is then based on the value of $f(\boldsymbol{b})$. It can be shown that, under the null hypothesis, $n^{-1/2} f(\hat{\boldsymbol{b}})$ has an asymptotic normal distribution with mean zero and a covariance matrix that is consistently estimated by

$$\sum{}_f = \left[\frac{\partial f}{\partial \boldsymbol{b}'} \right] \sum{}_b \left[\frac{\partial f}{\partial \boldsymbol{b}'} \right]' \quad (6)$$

Where $\partial f / \partial \boldsymbol{b}$ is the $(p+q)*(p+q)$ matrix whose (i, j)th element is the partial derivative of the ith member of f with respect to the jth member of $\boldsymbol{b}$, evaluated at $\hat{\boldsymbol{b}}$. Then, the Wald test statistic is

$$W = nf(\hat{\boldsymbol{b}})'\sum_{f}^{-1}f(\hat{\boldsymbol{b}}) \qquad (7)$$

Under the null hypothesis of noncausality, this statistic has an asymptotic distribution with $p+q$ degrees of freedom. The advantage of this approach is that it requires only the estimation of the unconstrained model. The Wald statistics of the test hypotheses are reported in Table 4. We cannot reject the first new hypothesis that foreign investors follow the exchange rate. But the predictive hypothesis is rejected. Therefore, foreign investors in the Korean stock market appear to wait for the market to move before they commit to a buying or selling program.

Table 4 Test for Foreign Investors Behaviour

Test Hypotheses	Wald Statistics
Follow the exchange rate hypothesis	1.53
Predictive exchange rate hypothesis	4.25

5. CONCLUSIONS

We have investigated the relationship between a price index of Korean stocks and the net purchases of Korean stocks by foreign investors. All data used in the paper are taken from the Korean Stock Exchange. The period studied is January 1992 to December 1997. First, we cannot reject the hypothesis that returns do not "Granger cause" trading. But we reject the hypothesis that trading does not "Granger cause" returns at the chosen significance level in all cases. Thus, causality seems to run in the direction predicted by both the informational trading and the noise

trading hypotheses. However, when directly tested, both are rejected for all three model specifications. These findings are somewhat surprising since they imply that foreign investors in the Korean market do not follow either type of behaviour. We then investigated the broader concept of "returns" to include foreign exchange gains/losses by testing two further hypotheses: "follow" or "predict" exchange rate movements. The predictive hypothesis was rejected. Therefore, it would appear that foreign investors in the Korean stock market wait for market movements before committing to a buying or selling program, a more conservative form of speculation than the rejected alternative.

DATA APPENDIX

P_t= purchase of Korean stocks by foreign investors.

S_t= sales of Korean stocks ++by foreign investors.

N_t= net purchases of Korean stocks by foreign investors.

X_t= net purchaes divided by total turnover.

r_t= log of Korean Stock Exchange Index. (It)

e_t= log of the rate of change in the Korean Won/US dollar exchange rate.

All data used in the paper are from Korea Stock Exchange. The period studied is January 1992 to December 1997.

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