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The Impacts of Foreigner Investment Opening Policy on the Taiwan Stock Market: An Application of the Intervention Model

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Abstract

The impacts of foreigner investment opening policy on the stock market has been seriously debated recently. The major purpose of this study is to investigate whether or not increasing the amount of foreigner investment will lead to more volatile stock market in Taiwan. The study applies the intervention model with the correction of outliers in time series. Nine stock index returns, two foreigner investment holding ratios, three successive foreigner investment opening policies are used in the study. Daily data is collected from April 1992 to December 1994. The total number of observations is 778. The findings are summarized as follows:

(1) The rates of changes in foreigner investment holding ratios could affect both the overall stock index (TWPI) and the FINANCE stock index returns. (2) The short run and long run impacts of different foreigner investment policies on the average stock returns have shown different results. (3) Outliers could exist in the sample period. Exogenous events should be controlled in order to obtain valid conclusions. (4) The increase in the maximum amount of foreigner investment does not necessarily increase the volatility of the stock market in Taiwan.

Key Words: Stock Market, Foreigner Investment Opening Policy, Intervention Model, TFARMA, Outlier Detection

1. INTRODUCTION

The issue of whether or not increasing the amount of foreigner investment resulting in more volatile stock market of Taiwan has been seriously debated recently. The Stock Exchange Committee of Taiwan (SEC) argued that the increase of the foreigner investment could reduce the volatility of the Taiwan's stock market since the major sources of the foreigner investment are from foreign institutional investors. On the other hand, the Central Bank of Taiwan argued that foreigner investment is a type of "hot money" and could encourage short-term speculative movements to the stock market resulting in higher volatility. No empirical research has focused upon the impacts of these policies on stock index returns so far. Meanwhile, it is unlikely that foreigner investors will invest their capital equally to different industrial sectors. The impacts of foreigner investment on each industrial sectors may not be the same. Thus, it is interesting to know how are the effects of foreigner investment on different industrial sectors. The SEC of Taiwan has changed foreigner investment policies several times throughout the years. The maximal(i.e., upper limits) foreigner investment allowed and their effective dates are US$2.5 billions on Dec. 29, 1990, US$5.0 billions on Aug. 19, 1993 and US$7.5 billions on Mar. 5, 1994, respectively. A crucial question to ask is: whether or not the increases in the maximal amount of foreigner investment by the SEC actually brought about larger volatility to the stock market? Thus, the objectives of this paper are to analyze the mean and volatility impacts of foreigner investment in different policy periods and in different industrial sectors.

To investigate whether the policy changes would affect market mean returns, the intervention model (IVM) is applied. Introduced by Box and Tiao(19 75), the IVM model is specifically designed for analyzing the impacts of policy changes by incorporating the exact timing of the policy change into the ARIMA model(Abrams, 1987; Mills and Stephenson, 1987; Harvey and Durbin, 1986; Bhattacharyaa and Layton, 1979). With the inclusion of the dummy variables, the IVM model can be treated as a reduced version of the Transfer Function Noise Model (TFARMA). To investigate whether the policy changes would affect market volatility, this paper will apply the Tsay's method(1988). The reasons for adopting Tsay's approach are because the traditional Student t distribution cannot be used in testing mean(or variance) level of time series because (1) successive observations may be correlated, and (2) the effect may affect several periods and not just a step change. Specifically, Tsay(1988) extends the IVM model to deal with level shifts, both temporary and permanent, and variance changes in time series. Thus, Tsay's method is suitable for studying the volatility changes in different policy periods.

In addition, policy changes and many other exogenous events could jointly affect the time series data. The exact impacts due to specific policy changes might not be known. Specifically, the aberrant observations caused by other exogenous events are called outliers in time series. Without proper correction, the estimated parameters of a time series model would be biased. The degree of biasedness depends upon the number, type, magnitude, and relative position of outliers (Tsay, 1986). Following the initial work of Fox(1972) and recent extensions by Tsay(1986), this paper would attempt to correct the outlier problem so that appropriate impacts of foreigner investment in different policy periods could be analyzed.

This paper is organized as follows: Section 1 discusses the objectives of the study and various statistical issues involved in analyzing the impacts of foreigner investment on the stock market in different policy periods. Section 2 presents the estimation methods for deriving and analyzing the empirical intervention model. Section 3 explains the major findings of the study. Finally, conclusions are given in Section 4.

2. DATA AND METHODOLOGY

2.1 Data Description

In this study, nine different stock index returns, including Taiwan Stock Exchange Weighted Price index (TWPI), Cement, Food, Petrochem, Textile, Elec&Mach, Paper&Pulp, Construct, and Finance stock indexes, are used as "index return" variables. Foreigner investment(including both institutional and individual) holding ratios in terms of market value or holding volume are used as the independent variables. The effective dates of three successive foreigner investment opening policies are used as the intervention variables. The daily data employed in this study is obtained from Commercial Times Database from April 7, 1992 to December 31, 1994, because foreigner investment holding ratios are available starting from April 7, 1992.

2.2 The Intervention Model (IVM)

Let X_t be generated by an ARMA(p,q) stationary process, and It be the intervention variable, an intervention model (IVM) can be expressed as:(Mills, 1990)

$$X_t = V(B)I_t + N_t$$

where

$$N_t = \frac{\theta(B)}{\phi(B)} a_t$$

V(B) is a (possibly infinite) polynomial which may admit a "rational" form, such as

$$V(B) = \frac{\omega(B)}{\delta(B)} B^b$$

where

$$\omega(B) = \omega_0 - \omega_1 B - \ldots - \omega_s B^s,$$
$$\delta(B) = 1 - \delta_1 B - \ldots - \delta_r B^r$$

"b" measures the "delay" in effect (or called "dead time"). I_t is the intervention variable and is a "dummy" or "indicator" sequence taking the values "1" or "0" to denote the occurrence or non-occurrence of the policy intervention. In general, there are three different forms of intervention:

(1) a "pulse" variable indicates a policy which is only effective at time T.

$$I_t = \varepsilon_t^{(T)}, \ \ where \ \ \varepsilon_t^{(T)} = \begin{cases} 1, & t = T \\ 0, & t \neq T \end{cases}$$

For a pulse input, if $V(B) = \omega/(1 - \delta B)$, and $0 < \delta < 1, I_t$ has only a transient effect on X_t , with ω measuring the initial increase and δ measuring the rate of decline. If δ is zero, only an instantaneous effect is occurred. If δ is one, the pulse input is really a step change and the effect is permanent.

(2) a "step" variable indicates a policy which is effective from the observation T to the end of period.

$$I_t = \xi_t^{(T)}, \ \ where \ \ \xi_t^{(T)} = \begin{cases} 0, & t < T \\ 1, & t \geq T \end{cases}$$

For a step input, if $V(B) = \omega/(1-\delta B)$, I_t has short run and long run effects on X_t , with ω measuring the immediate response and $\omega/(1-\delta)$ measuring the long run response. If δ is zero, a once-and-for-all step change is resulted. If δ is one, the step input creates a steady growth on X_t throughout the remaining time series.

(3) an "extended pulse" variable indicates "policy on - policy off" within a certain period.

$$I_t = \eta_t^{(T_1,T_2)}, \quad where \ \eta_t^{(T_1,T_2)} = \begin{cases} 1, \ T_1 \leq t \leq T_2 \\ 0, \ otherwise \end{cases}$$

The results of an extended pulse would be similar to those of a step input as discussed in case (2).

If there are J policy interventions, the above model can be extended as:

$$\nabla^d \nabla_s^D X_t = \sum_{j=1}^{J} \frac{\omega_j(B)}{\delta_j(B)} B^{bj} \nabla^d \nabla_s^D I_{jt} + \frac{\theta(B)\Theta(B^s)}{\phi(B)\Phi(B)} a_t$$

2.3 Outliers Detection in Time Series

In general, there are two types of outliers in time series: namely, the additive outlier (AO) and the innovational outlier (IO). The AO is also known as a "gross error" outlier since only a specific observation (i.e., at time "T") is affected. The IO is known as "influential error" outlier since an external shock at time "T" influences time series throughout the remaining periods. The mathematical expressions of these two types of outliers (without the inclusion of policy intervention variables) can be stated as follows.

(1) An additive outlier model (AOM) has the form:

$$X_t = \frac{\theta(B)}{\phi(B)} a_t + \alpha \cdot \varepsilon_t^{(T)}$$

(2) An innovational outlier model (IOM) has the form:

$$X_t = \frac{\theta(B)}{\phi(B)} a_t + \frac{\theta(B)}{\phi(B)} \alpha \cdot \varepsilon_t^{(T)}$$

Without loss of generality, this paper would adopt the IOM model. Then, the residuals can be expressed as:

$$\varepsilon_t = \frac{\phi(B)}{\theta(B)} X_t = \pi(B) X_t = \alpha \cdot \pi(B) \cdot \varepsilon_t^{(T)} + a_t$$

Thus, the best estimate of an IO at time T is e_t, and the variance of the estimates is σ_a^2. Under the null hypothesis that there is no outlier at time T, likelihood ratio statistic for the alternative of an IO can be stated as:

$$\lambda_{I,T} = \frac{\hat{e}_t}{\sigma_a}$$

Under this null hypothesis, this statistic has the standard normal distribution and can be tested directly in practice. Furthermore, since the existence of outliers can seriously affect the estimates of time series models, it is necessary to adopt an iterative procedure for detecting outliers. The iterative outlier detection procedure is listed below.

(1) Estimate traditional time series model. Then, compute residuals and the initial estimate of σ_a^2.

(2) Compute $\lambda_{I,T}$. If $\lambda_{I,T}$ is greater than some critical value, normally set at 3.5, an IO is found at time T. Notice that the effective dates of policy change for this study are designed as intervention variables (using dummy variable approach) in the initial time series model so that those important dates will not be identified as outliers.

(3) Insert the dates of those outliers found in step (2) as additional dummy variables into the initial time series model. The procedure may be iterated by going to step (1) with the modified model.

(4) After all outliers are identified, the final model can be estimated by combining both the IVM model and the IOM model.

2.4 The Full Empirical Model of This Study

By combining the IVM and IOM models and simplifying the estimation process, the full empirical model of this study is proposed as follows:

$$\nabla^d X_t = \frac{\theta(B)}{\phi(B)}\left(\frac{\gamma_0-\gamma_1 B}{1-\rho_1 B}\right)\nabla^d H_t + \sum_{j=1}^{J}\frac{\omega_{j0}-\omega_{j1}B}{1-\delta_{j1}B}\nabla^d I_{jt} + \sum_{k=1}^{k}\alpha_{k,T}\cdot\varepsilon_{k,T}^{(T)} + \frac{\theta(B)}{\phi(B)}a_t$$

where $\gamma_0, \gamma_1, \rho_1$ are the estimates of Holding ratio (H) parameters,$\omega_0, \omega_1, \delta_1$ are the estimates of intervention parameters, $\alpha_{k,T}$ are the estimates of outlier parameters, and a_t is a white noise. Since there are three policy periods, two policy dummy variables are designed as D50 and D75, indicating the 5- billion and 7.5-billion periods, respectively. Thus, for the 5-billion period, $I_{j,t} = D50 = 1$, otherwise, $D50 = 0$; for the 7.5-billion period, $I_{j,t} = D75 = 1$, otherwise, $D75 = 0$.

2.5 Test of Variance Changes in Time Series

To test whether or not the changes in foreigner investment opening policy would affect the volatility of the stock market in Taiwan, this study applies Tsay's proposition (1988) and redefines the variance change measure as:

$$b_t = \begin{bmatrix} a_t \\ a_t(1+V_{50}) \\ a_t(1+V_{75}) \end{bmatrix}, \text{ if } \begin{bmatrix} t < 93/08/18 \\ 93/08/19 \leq t < 94/03/04 \\ t \geq 94/03/05 \end{bmatrix}$$

where V_j is the long run response of intervention variables on the stock index returns, and is defined as:

$$V_j = \frac{\omega_{j0}-\omega_{j1}}{1-\delta_{j1}}$$

The variance ratio of b_t between two policy periods can be expressed as:

$$r_t = \frac{(T-1)\sum_{t=T}^{n} b_t^2}{(n-T+1)\sum_{t=1}^{T-1} b_t^2}$$

r_t is an estimate of $(1+V_j^2)$ and is distributed as F distribution with degrees of freedom equal to (n-T+1) and (T-1), respectively.

2.6 Estimation Procedure

Based on the empirical model specified in (2.4), the estimation procedure is organized as follows:

(1) Select the appropriate foreigner investment holding ratio for subsequent analysis. Since there are two types of holding ratios, i.e., in market value and in holding volume, correlation analysis between stock returns and holding ratio are checked, and one of the two holding ratios will be chosen for the study.

(2) Check the stationarity of time series by using Augmented Dickey-Fuller (ADF) test(Dickey and Fuller, 1979). The returns of nine stock indexes and the rates of change of foreigner investment holding ratios are checked separately.

(3) Detect outliers by using the intervention model approach. The iterative detection procedure is used for identifying outliers. Nine equations will be estimated separately.

(4) Estimate the final intervention models. Nine equations will be estimated separately.

3. EMPIRICAL RESULTS

All of the data in this study are transformed into the rate of change. Correlation analysis between stock returns and the rates of change of foreigner investment holding ratios are reported in Table 1. The correlation of stock returns with holding ratio in market value is much higher than holding ratio in holding volume. Thus, the holding ratio in market value is used as the independent variable in the empirical model. Notice that although the correlation coefficients shown here are relatively small concurrently, the lag structure between these variables may still exist, which is the major focus of this study.

By using TSP software, the ADF tests for stationarity of time series, with constant and trend terms, are reported in Table 2. The results show that all variables are stationary without differencing.

By using SAS/ETS procedure, the estimated intervention models with outlier dummy variables are summarized in Tables 3(a) and 3(b). The prewhitening process finds that both *Cement* and *Construct* index returns require moving-average adjustment. Based on the full model specified in section 2.4, the impacts of holding ratio are denoted as H(C), H(N,1) and H(D,1). H(C) is the estimate of constant term for the holding ratio. H(N,1) is the estimate of the first numerator coefficient in TFARMA model. H(D,1) is the estimate of the first denominator coefficient in TFARMA model. The results show that the

Table 1. Correlation Analysis for Stock Returns and Foreigner Investment Holding Ratios

	Foreigner Investment Holding ratio (Rate of Change)	
Stock Index Returns	In Market Value	In Holding Volume
TWPI	0.02384	-0.00817
CEMENT	-0.03486	-0.00226
FOOD	-0.01839	-0.00967
PETROCHEM	0.01251	-0.00913
TEXTILE	-0.02413	-0.00419
ELEC & MACH	0.05610	-0.00807
PAPER & PULP	-0.03126	-0.00849
CONSTRUCT	-0.00725	-0.00337
FINANCIAL	0.01779	-0.00811

Note: TWPI is the Taiwan Stock Exch. Weighted Price

Table 2. Augmented Dickey-Fuller Tests for Stock Returns and Foreigner Investment Holding Ratios(Dickey-Fuller t-statistic, with constant and trend, # lag=12)

		Foreigner Investment Holding ratio (Rate of Change)	
Stock Index	Stock Index Returns	In Market Value	In Holding Volume
TWPI	-7.0806 ***	-7.4188 ***	-7.7398 ***
CEMENT	-7.8711 ***	-7.9001 ***	-7.6775 ***
FOOD	-7.8930 ***	-8.0471 ***	-7.7615 ***
PETROCHEM	-7.8308 ***	-7.3981 ***	-7.6839 ***
TEXTILE	-7.5016 ***	-8.2836 ***	-7.8340 ***
ELEC & MACH	-7.6349 ***	-8.6671 ***	-7.7933 ***
PAPER & PULP	-8.3334 ***	-8.4068 ***	-7.7806 ***
CONSTRUCT	-7.2451 ***	-7.8587 ***	-7.6403 ***
FINANCIAL	-6.3785 ***	-7.4609 ***	-7.6799 ***

Note:Mackinnon Critical values: 1%=-3.9592; 5%=-3.4121; 10%=-3.1286.
*** indicates 1% significance level. Number of obs.=766.

Tabel 3(a) Estimated Parameters of the Intervention Models

Dep Var Param.	TWPI Estimate	t Ratio	CEMENT Estimate	t Ratio	FOOD Estimate	t Ration	PETRO Estimat	t Ratio	TEXTILE Estimate	t Ratio
Prewhitening Factors from Holding Ratio(H):										
AR(P)	12		1		2		12		(1, 2, 3, 4, 7)	
MA(4)			3, 11000	4. 00						
H(C)	0. 06032	1. 57	-0. 00294	-1. 01	-0. 00462	-0. 54	0. 00601	0. 38	-0. 08187	-0. 63
H(N, 1)										
H(D, 1)	0. 82349	3. 20								
D50(C)	0. 00156	1. 30	0. 00008	0. 46	0. 00460	0. 81	0. 00207	1. 60	0. 00516	2. 07
D50(N, 1)					0. 00316	0. 55				
D50(D, 1)			0. 94929	8. 19	-0. 91750	-5. 36			-0. 95214	-9. 99
D75(C)	0. 00011	0. 22	-0. 00003	-0. 04	0. 00115	1. 22	0. 00018	0. 22	0. 00146	1. 37
D75(N, 1)										
D75(D, 1)	0. 93386	2. 97					0. 91341	2. 32		
Outliers:										
920917	-0. 06083	-4. 27	-0. 04023	-3. 76	-0. 06296	-4. 37	-0. 05557	-3. 55	-0. 06188	-3. 78
920919			0. 04128	3. 86						
921006			-0. 04254	-3. 97						
921228										
930106			-0. 04281	-4. 00						
930130										
930212			0. 04504	4. 21						
930227										
930303	0. 05515	3. 87	0. 04419	4. 12	0. 06031	4. 18				
930304			0. 06000	5. 60						
931129	0. 05177	3. 60	0. 04139	3. 85	0. 05545	3. 83	0. 05858	3. 73		
931216			0. 04538	4. 21						
931223			-0. 04235	-3. 92						
940105	0. 05527	3. 86			-0. 05417	3. 75				
940113	-0. 06013	-4. 20	-0. 05172	-4. 79	0. 05131	-3. 55	-0. 05799	-3. 69		
940115	0. 05470	3. 83	0. 03820	3. 54	0. 05230	3. 62				
940929			0. 04483	4. 17						
941008	-0. 06246	-4. 37	-0. 04478	-4. 17	-0. 05536	-3. 83	-0. 06686	-4. 26	-0. 06345	-3. 87
941012	0. 05921	4. 14	0. 05053	4. 68			0. 05841	3. 72		
941101	-0. 05123	-3. 58					-0. 05891	-3. 75		
Basic Statistics:										
Variance	0. 00020		0. 00012		0. 00021		0. 00024		0. 00027	
Std Erro	0. 01425		0. 01078		0001441		0. 01565		0. 01638	
AIC	-4392. 79		-4821. 72		-4377. 22		-4250. 95		-4184. 02	
SBC	-4327. 60		-4728. 58		-4321. 34		-4204. 38		-4156. 08	
No. Obs.	778		778		778		778		778	
Ljung-Box Stat. :										
Lag #:	Chi-Squ.	P-val	Chi-Squ.	P-val	Chi-Squ.	P-val	Chi-Squ.	P-val	Chi-Squ.	P-val
6	2. 27	0. 893	7. 21	0. 206	4. 01	0. 676	5. 25	0. 512	3. 84	0. 698
12	11. 41	0. 494	12. 49	0. 328	5. 90	0. 921	12. 85	0. 380	10. 30	0. 590
18	16. 05	0. 589	16. 77	0. 470	11. 54	0. 870	19. 38	0. 369	12. 47	0. 822
24	26. 35	0. 336	25. 41	0. 330	16. 31	0. 876	33. 61	0. 092	19. 33	0. 734

Tabel 3(b) Estimated Parameters of the Intervention Models

Dep Var Param.	ELEC Estimate	t Ratio	PAPER Estimate	t Ratio	CONSTR Estimate	t Ration	FINANCE Estimat	t Ratio
Prewhitening Factors from Holding Ratio(H):								
AR(P)	3		5		2		1	
MA(12)					-0.10787	-2.95		
H(C)	0.01576	1.63	-0.03140	- 0.87	-0.00198	-0.30	0.01412	0.92
H(N,1)								
H(D,1)							0.78975	2.34
D50(C)	-0.00716	-0.96	0.01184	1.41	0.00322	1.34	0.00323	1.90
D50(N,1)	-0.00738	-0.94	0.00478	0.55				
D50(D,1)	0.92180	11.38	-0.93003	-10.55	-0.94856	-5.78		
D75(C)	-0.01984	-1.44	0.03447	1.75	0.00036	0.34	-0.00025	-0.18
D75(N,1)	-0.02009	-1.45	0.03205	1.61				
D75(D,1)	0.83922	5.92	-0.40939	- 0.87			-1.01387	-33.85
Outliers:								
920917	-0.06258	-4.12	-0.06768	-3.67	-0.05901	-4.11		
920919								
921006								
921228			-0.06501	-3.53				
930106					-0.04962	-3.46		
930130			0.06508	3.53				
930212								
930227					0.06423	4.48		
930303					0.06172	4.30		
930304								
931129	0.05816	3.81						
931216								
931223								
940105	0.05379	3.52			0.05527	3.83		
940113	-0.06132	-4.02	-0.06922	-3.75	-0.05804	-4.03		
940115	0.05298	3.47						
940929								
941008	-0.06663	-4.37	-0.06795	-3.68	-0.05644	-3.93		
941012	0.06019	3.95			0.05948	4.13		
941101								
Basic Statistics:								
Variance	0.00023		0.00034		0.00021		0.00042	
Std Erro	0.01520		0.01842		0.01443		0.02038	
AIC	-4292.78		-3995.39		-4373.67		-3844.61	
SBC	-4227.58		-3939.51		-4313.13		-3821.33	
No. Obs.	778		778		778		778	
Ljung-Box Stat.:								
Lag #:	Chi-Squ.	P-val	Chi-Squ.	P-val	Chi-Squ.	P-val	Chi-Squ.	P-val
6	3.85	0.696	8.08	0.233	2.74	0.741	6.61	0.358
12	6.90	0.864	16.56	0.167	10.90	0.452	19.35	0.080
18	12.16	0.839	23.51	0.172	19.96	0.276	25.85	0.103
24	26.06	0.350	32.73	0.110	25.88	0.307	30.38	0.173

changes in foreigner investment holding ratio could affect the returns of both TWPI and *Finance* indexes. The t-values in absolute term are greater than two in both cases.

The impacts of the second policy and the third policy on the stock index returns could be analyzed from D50 and D75, respectively. The estimated parameter of D50(C) indicates the initial impact of the 2nd policy. The estimated parameters of D50(N,1) and D50(D,1) indicate the short run and the long run responses of the 2nd policy, respectively. For the 2nd policy period, 1 out of 9 stock indexes (i.e., the *Textile* index) has shown significant immediate increase in returns, and 6 out of 9 stock indexes have shown significant long run impacts on returns.

The estimated parameter of D75(C) indicates the initial impact of the 3rd policy. The estimated parameters of D75(N,1) and D75(D,1) indicate the short run and the long run responses of the 3rd policy, respectively. For the 3rd policy period, none of the stock indexes has shown significant immediate change in returns, and 4 out of 9 stock indexes have shown significant long run impacts on returns.

In addition, for those parameters having significant estimated parameters(i.e., the absolute values of t-ratio are greater than two), if the estimated parameter is positive(negative), it implies there is positive(negative) policy impacts on stock index returns. The results of positive or negative estimated parameters are possible, because different stock indexes may respond to policy changes independently. However, there is another possibility that other external events may account for such difference. Hopefully, the outlier detection procedure incorporated in the study would be able to control for those external events.

The outliers found in the study show that many exogenous events exist in the sample period. The dates of those outliers are listed in the first column. In general, those outliers signify "external shocks to the system," which could be explained by investigating those specific dates. All of the stock indexes have shown significant numbers of outliers, except for Textile and Finance stock indexes. One possible explanation is both stock indexes are more robust against external shocks. Since they are not the primary purpose of the study, this study would skip those explanations. The AIC index is the Akaike Information Criterion for measuring system variance in logarithmic form(Akaike, 1974). The SBC index is the Schwartz Bayesian Criterion for measuring system variance in logarithmic form(Schwartz, 1978). Both AIC and SBC are used for selecting the best estimated model. The Ljung-Box statistics for the nine equations are reported. The results show that the residuals are white noises in all of the equations.

The tests for variance changes in three policy periods are reported in Table 4. From Table 4, RAT12 is the F-ratio between policy period one and policy period two. The results of the F-tests show that the estimated variances in the 2nd policy period are the largest among the three policy periods in all stock indexes. For the Petrochem, Textile, Paper&Pulp stock indexes, the estimated variances of the 3rd policy period are also greater than those of the 1st policy period. For the overall market index (TWPI), the volatility in the 2nd policy period is the largest, and there is no significant difference between the 1st and the 3rd periods. These findings indicate that the increase in the maximum amount of foreigner investment does not increase the volatility of the stock market in Taiwan.

Table 4 Tests of Variance Changes in Three Policy Periods

	Sum of Squared Errors(SSE)			F-Tests of Residual Variance												
	1st Period 92/04/07~93/08/18	2nd Period 93/08/19~94/03/04	3rd Period 94/03/05~94/12/31	RAT12		RAT13		RAT23		RAT21		RAT31		RAT32		Result
Index	Obs=391	Obs=149	Obs=238	F-Val	P-Val	F-Val	P-Val	F-Val	P-Val	F-Val	P-Val	F-Val	P-Val	F-Val	P-Val	
TWPI	0.00022	0.00025	0.00013	0.34	NA	1.05	0.34	3.09	0.00	2.94	0.00	0.95	NA	0.32	NA	V2>V1=V3
CEMENT	0.00013	0.00016	0.00007	0.31	NA	1.04	0.36	3.38	0.00	3.24	0.00	0.96	NA	0.30	NA	V2>V1=V3
FOOD	0.00025	0.00020	0.00014	0.48	NA	1.11	0.19	2.31	0.00	2.08	0.00	0.90	NA	0.43	NA	V2>V1=V3
PETRO	0.00022	0.00030	0.00024	0.29	NA	0.56	NA	1.96	0.00	3.47	0.00	1.77	NA	0.51	NA	V2>V3>V1
TEXTILE	0.00026	0.00030	0.00026	0.32	NA	0.60	NA	1.85	0.00	3.10	0.00	1.67	NA	0.54	NA	V2>V3>V1
ELEC	0.00022	0.00018	0.00012	0.45	NA	1.07	0.27	2.39	0.00	2.23	0.00	0.93	NA	0.42	NA	V2>V1=V3
PAPER	0.00031	0.00044	0.00035	0.27	NA	0.55	NA	2.00	0.00	3.66	0.00	1.83	NA	0.50	NA	V2>V3>V1
CONSTR	0.00023	0.00026	0.00014	0.35	NA	1.05	0.33	3.03	0.00	2.88	0.00	0.95	NA	0.33	NA	V2>V1=V3
FINANCE	0.00042	0.00065	0.00027	0.24	NA	0.95	NA	3.92	0.00	4.13	0.00	1.05	NA	0.26	NA	V2>V3=V1

Note: The F value of RAT12=(SSE1/df. of the 1st period)/(SSE2/d.f. of the 2nd period).

4. CONCLUSIONS

This study applies the intervention model with the correction of outliers for analyzing the impacts of foreigner investment opening policies on the stock market. The conclusions are summarized as follows:

(1) The rates of changes in foreigner investment holding ratios could affect both the overall stock index (TWPI) and the FINANCE stock index returns.

(2) The impacts of different foreigner investment policies on the average stock returns have shown different results. For the 2nd foreigner investment policy period, i.e., US$5.0 billions period, 1 out of 9 stock indexes has shown significant immediate increase in returns. 6 out of 9 stock indexes have shown significant long run impacts on returns. For the 3rd foreigner investment policy period, i.e., US$7.5 billions periods, none of the stock indexes has shown significant immediate change in returns. 4 out of 9 stock indexes have shown significant long run impacts on returns.

(3) Outliers could exist in the sample period. Exogenous events should be controlled in order to obtain valid conclusions.

(4) The increase in the maximum amount of foreigner investment does not necessarily increase the volatility of the stock market in Taiwan.

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