A Study of Factors Influencing Foreign Share Holdings in the Taiwan Semiconductor Industry

Mu-Fen Chao and Shing-Yau Chen

ABSTRACT: As the semiconductor industry grows globally, the ability to attract investments and capital from foreign institutions continues to become more competitive. This paper examines factors—including stock indexes, macroeconomic variables, and company financial statistics—that would influence the foreign investment ratio in the Taiwan semiconductor industry, based on panel data from 2004 to 2009. The major findings of this study are that three types of variables significantly influence a foreign institution's preference for firms in Taiwan. These findings could have important implications in decision making either for local investors who want to follow a foreign institution's investment strategy or for a firm's financial managers who want to draw a foreign institution's attention.

KEY WORDS: foreign share holdings, panel data, semiconductor industry.

The United States played a leading role in the early semiconductor industry; however, in the late 1990s, the slump in dynamic random access memory (DRAM) prices caused U.S. semiconductor firms to outsource some production functions to Asia (Brown and Linden 2005; Nieh 2004; Wang et al. 2006). This business model allows U.S. companies to take advantage of specialized skilled and semiskilled labor in the United States for design, fabrication, and key managerial functions while tapping into the lower cost of unskilled labor, land, and taxes in Asia for assembly (Brown and Linden 2005; Torok 1994). Recently, the volatility of technology stocks worldwide has increased due to the accelerated pace of interactions and competition between industry participants in multiple countries.

The semiconductor industry in Taiwan has blossomed over the past three decades by utilizing advanced organizational techniques to leverage existing technology, while continually expanding technical capabilities in design. By the mid-1990s, the industry had reached a level of output that placed it behind only the United States, Japan, and Korea. By the end of March 2011, Taiwan had 270 chip design, 3 mask, 14 wafer fabrications, and 64 wafer testing and chip packaging companies. With total revenue exceeding US$60 billion annually, the semiconductor industry in Taiwan has demonstrated astonishing growth and has become one of the major integrated circuit (IC) producers in the world.

Raising capital has likely been and will continue to be an important issue for the Taiwan semiconductor industry. The ability to attract the attention of foreign institutions has become critical, not only in order to gain infusions of foreign capital but also to entice local investment, because the majority of domestic investors in Taiwan usually pay close attention to foreign institutions' investment strategies and try to follow them. Therefore, understanding the criteria that foreign investment institutions use to choose stocks could be of great value to the Taiwan semiconductor industry.

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The dramatic reduction of barriers to foreign investment in recent years has led to increased investment by the global investment community. Some research has associated foreign investor behavior with equity market liberalization and liquidity and with dramatically improving portfolio performance (Dahlquist and Robertson 2004; French and Poterba 1991; Tesar and Werner 1995). Due to the expertise of foreign investors in research and analysis, many investors in Taiwan imitate their strategies, and this, in turn, has tightened the linkage between global and domestic economic markets. Because changes in one market lead to spillovers in others, national stock markets increasingly react to one another in terms of returns and volatility through foreign investors. A few conspicuous examples of the increasing interdependence and contagion in global stock markets include the huge collapses on Wall Street in October 1987, the Asian stock markets in late 1997, and the world financial crisis in September 2008.

As mentioned above, globalization and foreign investment occur through a growing process of economic integration among financial markets and an increasing path of foreign investment in the global market. Many researchers have examined the interrelationships and information transmission patterns among stock indexes and macroeconomic variables (Abugri 2006; Agmon 1972; Booth et al. 1996; Bredin et al. 2005; Roll 1988; Siklos and Ng 2001). Earlier research has explored dynamic interdependence, market integration among major world stock exchanges, and foreign investor preferences. Pioneering studies include Von Furstenberg et al. (1989), Roll (1992), Kang and Stulz (1997), Janakiramanan and Lamba (1998), Lin and Shiu (2003), Nieh (2004), and Bredin et al. (2005), among others. Relatively few studies have examined industry-based stock market interdependence in developing countries. Foreign institutions, fund managers, and market analysts tend to view company stocks through a sector lens rather than assessing stocks country by country (Bang and Beom 2004).

This paper examines foreign share holdings in the Taiwan semiconductor industry at different foreign factor levels (stock indexes, macroeconomic variables, and company financial statistics). The study focuses on correlating weekly data from January 2004 to December 2009. The central issues investigated are factors that affect foreign investment movement in Taiwan semiconductor companies.

Literature Review

This paper focuses on three areas. The first concerns shocks to local macroeconomic variables and global factors transmitted into market returns. The second is an analysis of stock market dynamic linkages and the connection with stock indexes in the related industry. The third aims to understand foreign investor behavior in equity markets and the preference for domestic equities.

Several studies have concluded that the strength of the stock market reaction to local macroeconomic variables is dependent upon the local authority's economic policy (see Beltratti and Morana 2006; Bilson et al. 2001; Chen 2009; Döpke et al. 2008; Maysami and Koh 2000). Deepening global market integration has resulted in a trend of economies that move in lockstep and in larger market reactions than those of the pre-1979 period (Johnson and Jensen 1993). More studies have investigated the effect of announcements of local macroeconomic data on foreign markets.

Technical innovations combined with bringing down trade barriers increased the ease of international capital movement (Kierzkowski 2000). Abugri (2006), Bredin et al. (2005), Johnson and Jensen (1993), Kim et al. (2009), and Nieh (2004) examined the effect of

rate changes (discount rate, interest rate, federal funds target rate, and Treasury bill rate) on foreign equity markets and found a potential to influence economic conditions in both local and foreign stock returns. Stavárek (2005) and Vygodina (2005) suggested that the relationship between stock prices and exchange rates changed over time from 1978 to 2005, and that this presented stronger long-run causalities in the late 1990s, especially in countries actively participating in the global economy. Higher foreign exchange rate variability tends to increase local stock market volatility. Kim et al. (2009) and Mun (2007) further found an increase (decrease) in foreign net buying following appreciation (depreciation) of the won relative to the U.S. dollar.

Related studies on integrating international financial markets have been the topic of much research since the 1990s (see Glezakos et al. 2007; Masih and Masih 1997; Roll 1988; Siklos and Ng 2001). Some studies have recently examined interdependence in an industry-based stock market. Roll (1992) found that the industry structure significantly explains national stock market correlations. In the context of globalization, the stock market of U.S. trading partners such as Taiwan, an important high-tech outsource country, must be more closely linked. Chang (2008) and Wang et al. (2006) demonstrated that U.S. stock indexes play a leading role in Taiwan high-tech stock indexes.

Finally, this study investigates the link between foreign investor behavior and equity markets. Financial market liberalization entices new institutional investors to local markets, bringing unknown changes of unknown magnitudes (Lin et al. 2007). Most previous research has focused on single-sided studies and stock volatility arising from foreign investor strategies (Brennan and Cao 1997; Choe et al. 1999; Wermers 1999) or on local stock purchases by foreign investors that have a positive and statistically significant impact on stock market performance (Clark and Berko 1997; Dahlquist and Robertson 2004; Kim et al. 2005; Lizardo and Mollick 2009). Well-developed financial techniques have proved the causality between foreign investment and stock returns. Froot et al. (2001) argued that foreign inflows are strongly influenced by past stock returns and have positive forecasting power for future equity returns in emerging countries (Samarakoon 2009).

Equities market findings demonstrate that foreign investors prefer large, well-known firms with high return-on-equity, high β value, and low return variability (Badrindath et al. 1989; Covrig et al. 2001; Dahlquist and Robertson 2001; Kang and Stulz 1997; Lin and Shiu 2003). These results imply that foreign investors prefer large firms that offer lower investment barriers, high return-on-equity, large turnover, and high stock liquidity.

There has not been extensive research exploring factors that influence foreign share holding and its relationship to macroeconomic variables and stock indexes. This paper considers three factors (macroeconomic variables, stock indexes, and company financial statistics) as potential factors affecting foreign share holdings. Panel data are used to examine time series data and conduct cross-section pooling analysis.

Data

To examine possible factors affecting foreign share holdings in Taiwan semiconductor firms, this study uses weekly data from 2004 to 2009. There are thirty-five listed semiconductor companies in Taiwan during the period. These companies can be divided into four categories: design, mask, fabrications, and testing and packaging. Detailed information is presented in Table 1.

Table 1. Categories of sample companies

Company code	Category	Company code	Category	Company code	Category	Company code	Category
1437	Testing and packaging	2363	Design	2449	Testing and packaging	3034	Design
2303	Fabrications	2369	Testing and packaging	2451	Fabrications	3035	Design
2311	Testing and packaging	2379	Design	2454	Design	3041	Design
2325	Testing and packaging	2388	Design	2458	Design	5471	Design
2330	Fabrications	2401	Design	2473	Design	6145	Testing and packaging
2337	Fabrications	2408	Fabrications	2481	Testing and packaging	6257	Testing and packaging
2338	Mask	2434	Fabrications	3006	Design	6286	Design
2344	Fabrications	2436	Design	3014	Design	8016	Design
2351	Testing and packaging	2441	Testing and packaging	3016	Fabrications		

Note: The company code is a government-assigned identifier from http://emops.twse.com.tw.

To observe changes in foreign share holding, the current work checks three kinds of factors including 306 observations of global and local economic variables, stock indexes, and financial statistics. This research was obtained from various economic databases of the United States, Taiwan, and Korea.

During the study period in September 2008, the United States experienced subprime mortgage crises that caused a "meltdown," which had a significant impact on global financial markets. One concern is whether this unique event caused an anomalous change in the structure of foreign institutions' investment in Taiwan. The monthly investment amounts from January 2004 to December 2009 are presented in Figure 1. Using a 5 percent subsample of seventy-two monthly data points, the moving Chow test, proposed by Hansen (2001), was employed to detect structural changes. The result is shown in Figure 2. Based on these results, there appears to be no structural change in the amount invested by foreign institutions during the study period.

To examine foreign investors' preferences, this research uses the methods employed by Zhang et al. (2009). Foreign investment holdings in Taiwan semiconductor companies are compared to the proportional value of semiconductor firms as compared to the total market capitalization of the thirty-five sample firms. Foreign investor weight is calculated as follows:

$$Fweight_{it} = \frac{W_{it}^{F} - W_{it}^{M}}{W_{it}^{M}} \times 100, \tag{1}$$

where W_{it}^{M} and W_{it}^{F} denote the weight of firm i in week t in the sample market portfolio and the portfolio of foreign investors, respectively.

$$W_{it}^{M} = \frac{MV_{it}}{\sum_{i=1}^{n_t} MV_{it}} \quad \text{and} \quad W_{it}^{F} = \frac{Fown_{it} \times MV_{it}}{\sum_{i=1}^{n_t} Fown_{it} \times MV_{it}},$$

where MV_{it} and

$$\sum_{i=1}^{n_t} MV_{it}$$

denote the market value of firm i in week t and the total market value of sample firms, respectively.

$Fown_{it}$ is the ratio of foreign equity ownership of firm i in week t.

We characterize foreign holdings relative to the sample market portfolio, and employ $Fweight_{it}$ as the dependent variable. Positive values of $Fweight_{it}$ imply that foreigners invest disproportionately more in firm i relative to the sample market portfolio, while negative values of $Fweight_{it}$ imply that foreigners invest less in firms relative to the market portfolio.

This study examines the relationship between foreign share holdings and three kinds of economic factors: (1) foreign and local economic variables (federal fund target rates, foreign exchange, and Taiwan's discount rate), (2) foreign stock market indexes (the U.S. Philadelphia Semiconductor Index, the Korean Semiconductor Index), and (3) company financial statistics (stock return, system risk-β value, and the weight of semiconductor firms in the MSCI Taiwan Index).

Table 2 lists Pearson correlation coefficients among these variables, showing some high correlation coefficients. This study checks whether any collinearity exists, using the variance inflation factor (VIF) test. After three iterations of VIF tests, we removed two

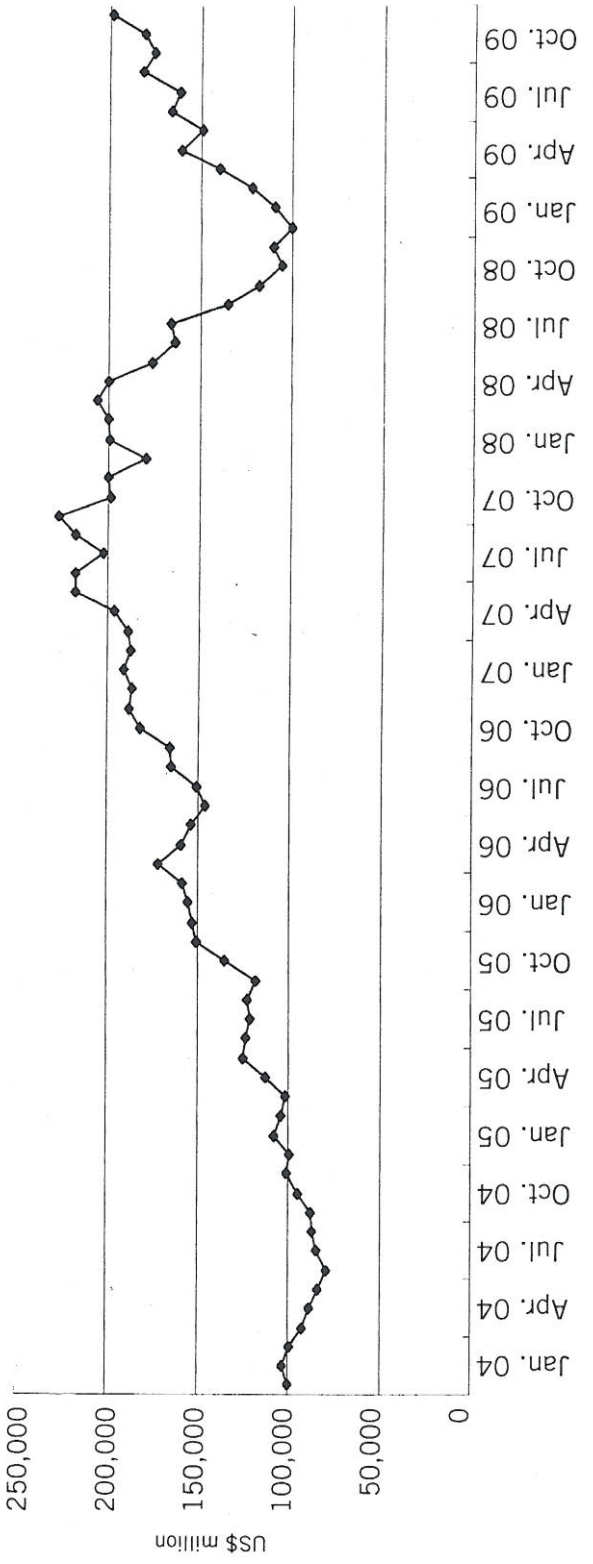

Figure 1. Total investment amount of foreign institutions in Taiwan

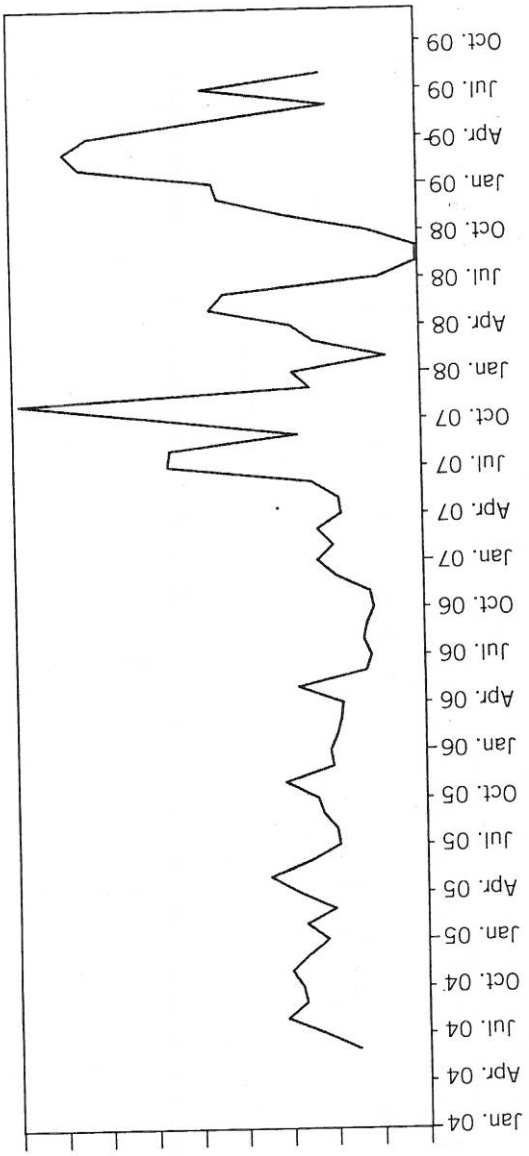

Figure 2. Result of moving Chow test

Note: The maximum LR *F*-statistic (11/2007) is 3.544307 and *p*-value is 0.7748.

Table 2. Pearson correlation coefficients between variables

Variables	*Fweight*	*TWR*	*TTRT*	*EX*	*SOX*	*KRX*	*TESI*	*NIKKEI*	*SR*	*ROI*	*MSCIT*
Fweight	1										
TWR	-0.016	1									
TTRT	0.023*	0.592**	1								
EX	0.024*	-0.112**	-0.002	1							
SOX	0.070**	0.695**	0.004	-0.050**	1						
KRX	-0.050**	0.187**	-0.004	-0.277**	-0.027**	1					
TESI	-0.010	0.385**	0.474**	-0.223**	0.296**	0.571**	1				
NIKKEI	0.006	0.030**	0.487**	0.032**	0.391**	0.334**	0.764**	1			
SR	0.053**	-0.018	0.017	-0.032**	-0.056**	-0.079**	-0.035**	0.029**	1		
ROI	-0.018	-0.105**	-0.006	0.051**	-0.003	0.041**	0.043**	0.060**	0.026**	1	
MSCIT	0.616**	-0.011	-0.001	0.008	0.004	-0.004	-0.003	0.004	0.037**	-0.002	1

Notes: The sample contains thirty-five Taiwan semiconductor firms listed on the Taiwan Stock Exchange (TEX). *Fweight* is the weight of foreign share holdings. *TWR* is the rediscount rate in Taiwan. *TTRT* is the federal fund target rate in the United States. *EX* is the foreign exchange rate in Taiwan. *SOX* is the U.S. Philadelphia Semiconductor Index. *KRX* is the Korea Semiconductor Index. *TESI* is the Taiwan Electric Stock Index. *NIKKEI* is the Nikkei 225 Index. *SR* is the system risk-β value. *ROI* is the ratio of stock return. *MSCIT* is the weight of semiconductor firms in the MSCI Taiwan Index. * and ** indicate rejection of the null hypothesis at 5 percent and 1 percent, respectively.

variables due to low correlation: the Nikkei 225 Index and the Taiwanese electric stock index. This leaves eight variables. Table 3 shows the VIF test results.

Hypotheses

As indicated in the literature review, this study examines the hypothesis that there is a correlation between foreign share holdings and three specific types of factors. The hypothesis is proposed in three sections as follows:

In global and local macroeconomic variables, many studies have examined the influence of interest rates on the stock market (see Abugri 2006; Bredin et al. 2005; Kim 2009; Nieh 2004). The discount rate and federal funds target rate have been used as the operational definition of interest rate in some studies (Bonomo et al. 1993; Bredin et al. 2005; Mann et al. 2004). Therefore, the first set of hypotheses is:

Hypothesis 1: Foreign investors will change share holdings when the Taiwan discount rate changes.

Hypothesis 2: Foreign investors will change share holdings when the U.S. federal funds target rate changes.

Hypothesis 3: Foreign investors will change share holdings when the Taiwan foreign exchange rate changes.

In a study examining industry-based stock markets' interdependence, Roll (1992) found that industry structure explains national stock market correlations. As an important country with high-tech outsources, Taiwan has close correlations with other countries. The United States is an important trading partner for Taiwan, but Korea is a competitor. Both can affect revenues of the Taiwan semiconductor industry, which leads to the following set of hypotheses:

Hypothesis 4: Foreign investors will change share holdings when the U.S. Philadelphia Semiconductor Index changes.

Hypothesis 5: Foreign investors will change share holdings when the Korean Semiconductor Index changes.

A great deal of research has focused on foreign investors' preference for large, well-known companies with high return-on-equity and high β value (see Covrig et al. 2001; Dahlquist and Robertson 2001; Kang and Stulz 1997; Lin and Shiu 2003). Thus, the last set of hypotheses is:

Hypothesis 6: Foreign investors should increase share holdings of high-beta firms relative to low-beta firms.

Hypothesis 7: Foreign investors should hold more shares in firms with high return on investment ratios.

Hypothesis 8: Foreign investors should hold more shares in well-known firms (firms with larger MSCI weight) than in small firms.

Methodology and Empirical Results

This study examines the factors affecting foreign share holdings in the semiconductor industry in Taiwan. By using the panel data model, we collect empirical data from thirty-five proper firms over 306 weekly periods (2004–9).

Table 3. VIF test

Variables	*TWR*	*TTRT*	*EX*	*SOX*	*KRX*	*SR*	*ROI*	*MSCIT*	*TESI*	*NIKKEI*
VIFI	3.49	9.408	1.567	7.188	8.505	1.061	1.032	1.001	12.726	18.138
VIFII	3.155	3.929	1.506	5.289	7.863	1.061	1.028	1.001	12.647	—
VIFIII	2.796	3.912	1.500	2.488	1.233	1.039	1.028	1.001	—	—

Note: After the VIF value is over 10, the variable is discarded.

Panel Data Analysis

Panel data analysis has the advantage of using cross-section and time-series information for analyses. The analysis also takes into account the heterogeneity of each cross-sectional unit explicitly by allowing for individual-specific effects.

The estimation procedure for panel-data regression models is to test whether the sample can fit the fixed effects (FE) model or the random effects (RE) model by sample suitability. The following introduces the estimation of two models.

The fixed effects model assumes that the regression constant varies across individuals (countries, firms, etc.), that is, the intercept varies over individual cross-section units but does not vary over time, written as follows:

$$Y_{it} = \alpha_0 + \alpha_1 D_1 + \ldots + \alpha_N D_N + \beta' X_{it} + \varepsilon_{it}, \quad i = 1,\ldots,N, t = 1,\ldots,T, \tag{2}$$

where Y_{it} denotes the foreign share holdings of firm i in the tth week, α_i is treated as an unknown parameter to be estimated, and the dummy variables, D_i, account for the influence from observed variables, which may differ across the cross-section units. X_{it} is a row vector of all endogenous variables. β' is a column vector of the common slope coefficients for the thirty-five firms, and dim $(\beta') = K$. ε_{it} is an error term:

$$\varepsilon_{it} \overset{iid}{\sim} (0, \sigma^2).$$

If the unobserved individual heterogeneity does not exist, then the slope coefficients are constant for all cross-section units and the model is called a random effect model, formulated as:

$$Y_{it} = \alpha + \beta' X_{it} + \mu_{it}, \mu_{it} = \mu_i + \lambda_t + \varepsilon_{it}, \quad i = 1,\ldots,N, t = 1,\ldots,T \tag{3}$$

$$\mu_t \overset{iid}{\sim} (0,\sigma^2), \lambda_t \overset{iid}{\sim} (0,\sigma^2), E(\varepsilon_{it}) = 0, Var(\varepsilon_{it}) = \sigma_v^2,$$

where α is the mean for the average intercept of population and μ_i is a random error term that reflects individual differences changing over individual cross-section units, but does not vary over time; λ_t represents time effects. The two error components μ and λ are assumed to be independent of each other.

Model Suitability

We chose to evaluate the Panel OLS (ordinary least squares), fixed effects, and random effect models to determine which is most suitable for this study.

Poolability Test

The simplest poolability test has as its null hypothesis the panel OLS model,

$$Y_{it} = \alpha + \beta' X_{it} + \nu_{it},$$

and as its alternative model,

$$Y_{it} = \alpha + \beta' X_{it} + \mu_i + \nu_{it}.$$

We test for the presence of individual effects:

$$H_0: \mu_i = \mu_2 = \ldots = \mu_N = 0.$$

According to the construction principle, we could use the F-statistic,

$$F = \frac{(SSE_R - SSE_U)/(N-1)}{SSE_U/(NT-N-K)} \sim F(N-1, NT-N-K), \tag{4}$$

where SSE_R denotes the residual sum of squares under the null hypothesis, and SSE_U denotes the residual sum of squares under the alternative.

Alternatively, we can also use the likelihood ratio statistic (LR),

$$LR = 2(\log L_U - \log L_R), \tag{5}$$

where $\log L_U$ denotes the restricted maximum likelihood value and $\log L_R$ denotes the unrestricted maximum likelihood value, asymptotically distributed as χ^2 under H_0 (the restricted model). If the statistic is significant, not all individuals are sufficiently homogeneous, and FE models need to be specified.

Tests for Random Effects

The RE model tests whether there exist any individual effects μ_i or time effects λ_t. The hypothesis is written as

$$H_0: \sigma_\mu^2 = \sigma_\lambda^2.$$

Likelihood can be evaluated under all hypotheses of concern, $LR = 2(\log L_U - \log L_R)$, where L_U denotes the likelihood for the unrestricted (general) model and L_R denotes for the restricted (specific) model, distributed as

$$\frac{1}{4}\chi^2(0) + \frac{1}{2}\chi^2(1) + \frac{1}{4}\chi^2(2),$$

which is a mixture of three χ^2 distributions. Most researchers use the Lagrange multiplier (LM) test, with the same result as LR tests.

Hausman Test

Assuming that Equation (3) is the random effects model and Equation (2) is the fixed effects model, the hypothesis is as follows:

$$\begin{aligned} &H_0 : \beta_{FE} = \beta_{RE} \\ &H = (\beta_{FE} - \beta_{RE})'[Var(\beta_{FE}) - Var(\beta_{RE})]^{-1}(\beta_{FE} - \beta_{RE}) \sim \chi^2(k), \end{aligned} \tag{6}$$

where β_{FE} is efficient, but inconsistent, under the null hypothesis. However, β_{RE} is consistent under both hypotheses, possibly without attaining efficiency under any hypothesis. If the statistic is significant, the FE model appears attractive and should be used to check the FE model likelihood ratio statistic again to confirm the dummy variables.

Results of Analysis

This section describes our analysis of a suitable model to explore the resulting implications. Based on the F-test, LR test, and Hausman test, the fixed effects model is the most suitable one.

Table 4. Results of model tests

Model	Panel OLS	Fixed effects	Random effects
F-statistic		1,222.1560 (0.000)***	
Hausman test		31.9110 (0.000)***	
LR		17,010.8700 (0.000)***	
R^2	0.46109	0.87496	0.38787

Notes: We chose not to employ a weight statistic estimate in this study. ***, **, and * significant at 1 percent, 5 percent, and 10 percent, respectively. *p*-values are in parentheses.

Suitable Model

The first step is to evaluate the Panel OLS Model from the *F*-test. The resulting statistics are significant, indicating that not all firms in the sample are sufficiently homogeneous and, therefore, the FE and RE models are more suitable than the OLS model. Table 4 shows the results of tests.

The second step uses the Hausman test to determine that the value of χ^2 is 31.9110 and the *p*-value is 0.001, indicating that the FE model could be a proper model. Although the FE model is inefficient because the dummies cause degree of freedom loss, the LR statistics is significant and the R^2 is higher for the FE than the RE model, so the dummies in the FE model are essential. Therefore, this result indicates that the FE specification is preferable.

Results

From the Hausman and LR test, this study finds the FE model to be preferable; therefore, the regression model in this study consists of eight variables, expressed as follows:

$$Fweight_{it} = \alpha_0 + \alpha_1 D_1 + \ldots + \alpha_N D_N + \beta_1 TWR_t + \beta_2 TTRT_t + \beta_3 EX_t + \beta_4 SOX_t + \beta_5 KRX_t + \beta_6 SR_{it} + \beta_7 ROI_{it} + \beta_8 MSCUT_{it} + \varepsilon_{it}. \quad (7)$$

In Table 5, the results reveal that all variables are statistically significant at 1 percent and 5 percent, respectively. Furthermore, as expected, the results show a negative sign for ratio of stock return, federal fund target rate, and the Korean Semiconductor Index, as well as a positive sign for the weight of semiconductor firms in the MSCI Taiwan Index, the foreign exchange rate in Taiwan, the discount rate in Taiwan, and the U.S. Philadelphia Semiconductor Index.

These findings are consistent with the panel data analysis and with our research hypotheses, except for H6 and H7. A U.S. Federal funds rate increase will make U.S. investments appear relatively attractive, enticing foreign firms to reduce investments in the Taiwan market. Similarly, when the Korean index value rises, it will attract foreign investment, moving funds from Taiwan to Korea. However, in contradiction to H6, there is an inverse relationship between system risk-β value and foreign share holdings, because higher risk-β value leads to lower foreign investment. In contradiction to H7, the ratio of stock returns has a negative coefficient indicating that foreign investors prefer to hold equity in firms with long-term potential instead of short-term performance gains.

Other variables have a positive coefficient. Foreign investors clearly favor firms with large market capitalization and high weight in the MSCI Taiwan Index. In addition, depreciation of the domestic currency causes export demand to increase in

Table 5. Regression results for the foreign share holdings markets model

Dependent variable: Foreign share holdings

	Panel OLS			Fixed effects			Random effects		
	Coefficient	*t*-statistic	*p*-value	Coefficient	*t*-statistic	*p*-value	Coefficient	*t*-statistic	*p*-value
Constant	−107.753	−13.054	0.000***	−100.516	−17.102	0.0000***	−119.991	−9.254	0.000***
TWR	0.025	1.844	0.065*	0.778	2.959	0.0031***	1.473	2.539	0.011**
TTRT	0.697	−4.191	0.000***	−0.861	−6.473	0.0000***	−1.204	−4.101	0.000***
EX	0.680	3.043	0.002***	0.797	4.8892	0.0000***	1.002	2.784	0.005***
SOX	−0.003	8.153	0.000***	0.039	17.738	0.0000***	0.043	8.959	0.000***
KRX	0.212	−4.135	0.000***	−0.005	−10.749	0.0000***	−0.004	−4.076	0.000***
SR	9.252	0.674	0.500	−1.234	−5.433	0.0000***	2.372	4.882	0.000***
ROI	0.212	−2.010	0.044**	−0.051	−2.872	0.0041***	−0.076	−1.944	0.052
MSCIT	−0.780	94.826	0.000***	1.224	3.293	0.0010***	9.402	81.073	0.000***
R^2	0.461089	0.874961	0.38787						

Notes: ***, **, and * significant at 1 percent, 5 percent, and 10 percent, respectively.

Table 6. Coefficient of cross-section units for foreign share holdings

Fixed effects (cross) of semiconductor industry companies in Taiwan

No.	Company code	Coefficient	No.	Company code	Coefficient
1	1437	-24.407	10	2363	-15.010
2	2303	40.900	11	2369	-5.924
3	2311	87.305	12	2379	17.722
4	2325	72.913	13	2388	-13.312
5	2330	85.171	14	2401	5.3347
6	2337	-5.548	15	2408	-21.224
7	2338	-14.496	16	2434	-23.042
8	2344	-12.965	17	2436	-30.206
9	2351	-31.999	18	2441	-4.661
No.	**Company code**	**Intercept**	**No.**	**Company code**	**Coefficient**
19	2449	1.0365	28	3034	29.464
20	2451	-16.129	29	3035	-0.346
21	2454	47.200	30	3041	-22.964
22	2458	-5.481	31	5471	-19.007
23	2473	12.397	32	6145	8.697
24	2481	-24.782	33	6257	-21.019
25	3006	-23.437	34	6286	17.627
26	3014	-32.908	35	8016	-24.024
27	3016	-32.878			

Notes: The table shows the results of cross-section units intercept and statistics on firms' characteristics and the weight of foreign share holdings computed using Equation (1).

the semiconductor industry, which makes Taiwan semiconductor firms more attractive to foreign institutions. Another positive correlation was found between the U.S. Philadelphia Semiconductor Index and the Taiwan semiconductor industry. When the semiconductor index in the United States increases, it causes a similar movement in the Taiwan market.

Table 4 shows that the FE model is well fitted, as it passes all the diagnostic tests. Table 6 shows the coefficient of cross-section firms. We recognize that foreign investors might not have the same preference in all firms. The findings show that the higher the coefficient, the greater the preference for foreign investors to hold that specific company. For example, the Taiwan Semiconductor Manufacturing (TSMC; company code: 2330) coefficient of 85.171 is higher than ITE Tech. (company code: 3014), with an intercept of –32.908, which means that foreign investors own a larger proportion of the shares of TSMC than shares of ITE.

Other firms with positive intercepts, such as United Microelectronics Corp. (company code: 2303), Advanced Semiconductor Engineering (company code: 2311), and Siliconware Precision Industries (company code: 2325), also exhibit greater than average interest from foreign investors.

Conclusion

This study employs a panel data model to investigate the relationships between three kinds of variables and foreign share holdings. The empirical results show that all variables examined affect foreign share holdings in the Taiwan semiconductor industry.

By using a rich data set on equity ownership, macroeconomic variables, stock indexes, and firm-specific financial statistics, we are able to characterize the variables that affect foreign share holdings in Taiwan semiconductor firms in great detail. Understanding these variables should help management to anticipate when foreign firms will withdraw their funds and when they will look to increase investment in the Taiwan market. When the discount rate in Taiwan rises, the federal fund target rate in the United States goes down, or the New Taiwan dollar appreciates against the U.S. dollar, then raising capital from foreign investors will be easier for the Taiwan semiconductor industry. Furthermore, foreign investors will allocate a higher percentage of their funds to Taiwan when the U.S. Philadelphia Semiconductor Index rises or the Korea Semiconductor Index goes down.

Foreign investors seem to prefer firms with a lower beta and higher weight in the MSCI Taiwan Index. Surprisingly, a lower rate of stock return seems to attract more foreign investment, perhaps because stock prices are more attractive.

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