Journal of Business Theory and Practice
ISSN 2372-9759 (Print) ISSN 2329-2644 (Online)
Vol. 3, No. 2, 2015
www.scholink.org/ojs/index.php/jbtp

Financial Liberalization, Economic Growth and Investment Strategy: Lessons from Taiwan for New Industrial Countries 2001.Q1~2015.Q2

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Abstract

To examine the impact of foreign capital inflows on Taiwan's economy after internet bubbles of 2000, this study adopts data from the first quarter of 2001 to the second quarter 2015 to test if foreign capital inflows have positive impacts on Taiwan's economic growth. This study also uses program trading and aims to prove that with financial liberalizations, the investment efficiency of foreign institutional investors is better than domestic institutional investors.

The results from the error correction model shows that capital formation, domestic savings and foreign direct investment all have positive relationships with the real economic growth. However, the rate of financing and foreign debt and depreciation all have negative relationships with the real economic growth. The results are all statistically significant. Hence, they do not completely support the hypothesis that foreign capital inflows are beneficial for economic growth.

Moreover, this study proves that the futures market in Taiwan is not strong-form market efficient. This result provides support for the hypothesis that the investment efficiency of foreign institutional investors is higher than that of domestic institutional investors. Investors can therefore raise their investment performance by following the investment strategies of foreign institutional investors.

Keywords

AK model, VECM, cointegration test, program trading

1. Introduction

In Taiwan, the average GNI increased from US$153 to US$20,537 for the period from 1961 to 2001, showing a growth of 134%. Especially during the 20-year period between 1952 and 1973, the average annual economic growth rate reached 9.88% and the income distribution was very even. As a result, Taiwan had become a model of economic development for new industrial countries (Kuo et al., 1981). However, after 1980s, Taiwan economy experienced modernized transformation. The leading industrial

production changed from the traditional textile and petrochemical industries to electronic and information technology. At the same time, the Taiwan economy abandoned tight restrictions, centralization and monopolization, and moved towards liberalization, globalization and institutionalization. At the beginning of the 21st century, due to the internet bubble, internal policital conflicts, cross-straight policital tensions between mainland China and Taiwan, finaical crisis and European debt crisis, Taiwan showed signs of economic recession in almost 50 years.

The financial liberalization became very common in the 1970s and flourished in the 1990s. The short-term international capital flow was popular and was the result of financial lilberalizations. The Taiwan government also followed this global trend and proceeded with several financial reforms, including marketization of interest rates, relinquishment of foreign exchange rate restrictions, and capital market opening. For example, the Taiwan government allow the loan interest rates to float in 1975 and canceled the control on interest rates in 1989. The Taiwan governemnt adopted the managed floating exchange rate system in 1979 and changed to free floating exchange rate system in 1989. At the same time, the daily volatility restriction of 2.25% was abandoned.

In terms of capital market opening, the Taiwan government opened up for Qualified Foreign Institutional Investors (QFIIs) to invest in the domestic stock market in 1991 in order to raise the weighting of institutional investors in the market, increase capital supply and enlarge the market size. In 1992, the Taiwan government graudally relaxed the restrictions on short-term capital flow and allowed for higher capital outflow. In the following year, foreign futures trading was allowed. In 1996, foreign individual investors could invest in the Taiwan stock market. Securities lending by foreign investors was allowed for in 2007[1]. In 2015, foreign investment in Taiwan stock market reached NT$9 billion, representing about 38% of the total market. The securities lending by foregin investors was over 90% in the securities lending market. The data showed that foreign investors were key players in the Taiwan stock market. While foreign investors held a high level of stocks and there were no required covering period of securities lending by foregin investors, foregin institutional investors were likely to use securities lending and then short sell in the market, causing big falls in the stock prices and great loses to other investors. The first time this situation happened was during the financial crisis in 2008 where the TAIEX fell by 59.88% from 9859 to 3955. The second time was in July 2011 where the European debt crisis caused the index to fall by 22%. The most recent fall in Taiwan stock market was casued by the fall in China stock market and the Greece debt crisis which also led to big volatility in stock markets worldwide. During this time, the foreign institutioanl investors had securities lending amounted to NT$360 billion and the TAIEX dropped by 15.6% from 10014 in late April in 2015 to 8442 on August 7. The degree of this fall was ranked No. 6 among the global markets[2]. The average daily trading volume also decreased by more than 30% from NT$120 billion in April 2015 to about NT$80 billion in July 2015.

According to the report by the Central Bank of Taiwan, since the global financial crisis, there were large outflows of domestic capital. The financial account of balance of payment was negative for a

continuous 19 seasons, amounting to US$187.8 billion[3]. Therefore, on the one hand, Taiwan had net capital outflows with positive current account and high foreign reserve of US$421.9 billion. On the other hand, Taiwan had attracted large capital inflows by foreign institutional investors. This fact suggested that the investment tools in Taiwan were not sufficient. The efficiency was also not enough and the returns were too low. As a result, capiatl flew out to seek for better investment returns. This also suggested that the Taiwan stock market, which had a relatively small market size, was vulnerable to foreign capital flows. That worsened the domestic investment environment despite that Taiwan possesed a high level of foreign reserves. Therefore, this study posed a puzzling question, "How can financial liberalization lead to a fragile market?".

Accordingly, this study not only examines if capital inflows from foreign instiutional investors are beneficial to Taiwan's economic growth but also conducts tests using program trading to see if investors in developing countries can make sustainable profits by following the investment strategies of foreign institutional investors. The organization of this paper is as follows. The literature review is provided in Section 2. In Section 3, we discuss the methods used, including Vector Autoreg Ression (VAR), variance decomposition function, granger causality test, cointegration and Vector Error Correction Model (VECM). The estimation methods based program trading are also discussed in this section. Descriptions of the data and the results are provided in Section 4 and 5, respectively. A conclusion is provided in Section 6.

2. Literature Review

McKinnon (1973) argues that explanations for the economic growth will be incomplete if we ignore the finance. Lucas (1988) examines the nexus between finance and economic growth and argues that we have over-stressed finance as a determinant of economic growth. As the use of finance in the economy largely depends on policy makers, the impact of financial reform on economic growth is still unclear.

In terms of economic growth, in the past twenty years a number of studies have examined the cause and effect relationship between financial development and economic growth in some countries. Although the complexity of the quantitative methods used differ largely across studies, most of these studies adopt the VAR method. For example, based on Korean data between 1971 and 2002, Yang and Yi (2008) use the super-exogeneity methodology and find that financial development is beneficial to economic growth but not vice versa. The implication from the study is that Korean government should focus on financial reforms rather than economic growth.

However, Allen et al. (2005) find that although China has a distorted financial system, it has the most rapid economic growth. Yao and Yueh (2009) also discover that although the Chinese law system and financial market are not well developed, in the past thirty years China had significant economic growth. The evidence suggests that a distorted financial system may not inhibit economic growth. Recent findings reveal that financial development usually leads to economic growth especially for developing countries compared to industrial countries (Green & Murinde, 2005).

Moreover, in terms of economic development, the oppositions propose that financial liberalization increases the risk in regional finance. Freixas (2004) suggests that foreign financial institutions and financial innovations will increase the information asymmetry and lower the effectiveness of financial supervision. Based on the game theory, Schinasi (2007) shows that small countries have uneven responsibilities relative to their economy size. As a result, the Nash equilibrium moves towards the lower welfare equilibrium and therefore the probability of financial crisis in small countries increases. Reinhart and Reinhart (2008) examine the real GDP, inflation rate and real exchange rate of 181 countries for the period between 1980 and 2007 and find that large inflow of foreign capital causes a fall in stock prices and an increase in housing prices. Bandiera et al. (2000) and Hermes and Lensink (2008) report that financial liberalizations will cause a decrease in domestic savings. Eichengreen and Leblang (2003) examines the capital account for the period 1880-1997 and find that when there is instability in financial markets, financial restrictions are beneficial to economic growth.

On the other hand, some believe that financial liberalizations can lead to regional financial stability. Levine et al. (2000) use 34 OECD member countries as the sample and prove that financial liberalizations can eliminate the tensions of international financial institutions in cross-region trading and is beneficial to regional financial stability and economic development. Dilyard and Gray (2002) treat financial intermediations as basic financial facilities. The more well-built the financial facilities, the lower the trading costs. Therefore, higher efficiency can lead to better regional financial stability. Favilukis et al. (2012) use 11 countries for the period 2002-2010 as the sample and find that foreign capital inflows (measured by the ratio of current account deficit to GDP) do not affect on asset prices. They believe that foreign capital inflow is not the cause of housing bubble before the financial crisis. In comparison to Pagano's (1993) AK model, Evans et al. (2002) use panel data covering 82 countries and 21 years of data to analyze how human capital and financial development contribute to economic growth based on production functions. Their results show that the interaction between human capital and financial departments is significant. Therefore, financial development is as significant as the growth of human capital.

In addition, the new economic growth theory proposed in the 1980s has two main developments. The first emphasizes that technological advances rely on knowledge capital or human capital. The representative work is by Romer (1986) who develops the knowledge-driven model. The second emphasizes that technological advances depend on capital accumulation including physical capital and human capital. The representative work is the AK model developed by Pagano (1993). This study adopts the AK model and the econometric methods to test the above arguments and examine the effect of foreign capital to Taiwan's economy. If the co-integration matrix cannot significantly prove the long-term positive effect of foreign capital on economic growth, the result then suggests that foreign capital does not help Taiwan's economic growth. Moreover, this study uses a practical method, program trading, to test if investors of developing countries can make consistent profits by following the footsteps of foreign institutional investors. The hypotheses to be tested are as follows:

H1: Foreign capital inflow has real benefits to Taiwan's economic growth.

H2: The investment efficiency of foreign institutional investors is higher than that of domestic institutional investors. Investors can improve their investment performance by following foreign institutional investors' investment strategies.

3. Estimation Theory and Methods

3.1 AK Model and the Estimation Methods

3.1.1 The Closed Economy

How capital transforms from savings to investment is not dealt with in the traditional economic growth model. In reality, the interaction between savings supply and investment demand is a dynamic process. Pagano (1993) use the simplest endogenous growth AK model to explain how financing policy in a capital market affects economic growth endogenously. Suppose the total output is a linear function of capital stock and A is the capital output rate (or technical coefficient), the AK model is presented below:

$$Y_t = AK_t \tag{1}$$

If the population size does not change and there is only one social product that can be used for investment or consumption, the depreciation rate = δ, and investment = I_t, then next year's capital stock is $K_{t+1} = I_t + (1-\delta)K_t$. In a closed economy, the equilibrium condition of the capital market is savings (S_t) being equal to investment (I_t). If savings is represented as a ratio of investment (θ) then:

$$I_t = \Delta K_t + \delta K_t = \theta S_t \tag{2}$$

Since $Y_t = AK_t$, the economic growth rate at period t + 1 is $g_{t+1} = \frac{Y_{t+1}}{Y_t} - 1 = \frac{K_{t+1}}{K_t} - 1$. In a stable economy, if savings $s = S/Y$, then the economic growth rate is $g = A\theta\frac{S_t}{Y_t} - \delta = A\theta s - \delta$. This shows that economic growth is dependent on capital output rate (A) and saving rate (S_t) and on saving being transformed to investment rate (θ):

$$A_t = \alpha_0 + \alpha_1(K/GDP) + \mu_t \,;\, \theta_t = \beta_0 + \beta_1(FUND/S) + \upsilon_t \,;\, s_t = \gamma_0 + \gamma_1(S/GDP) + \omega_t$$

Therefore, the endogenous growth model in a closed economy is specified as follows:

$$g = c_0 + c_1(K/GDP) + c_2(FUND/S) + c_3(S/GDP) + c_4(\delta) + \varepsilon_t \tag{3}$$

3.1.2 The Open Economy[4]

In an open economy, the investment of capital inflow country is derived from two sources: (1) savings S_t which is transformed to real investment $I_{dt} = \theta S_t$; (2) capital inflow which becomes investment $K_f = \beta K_F$ where $\varphi(0 \le I_{dt}/S_t \le 1)$ is the transformation efficiency of financial services and

coefficient of domestic capital. $1-\varphi$ is the yield rate of financial services provided by financial intermediation and represents the loss during the transformation process from savings to investment. $\beta(0 \le \beta = K_f / K_F \le 1)$ is the coefficient of capital inflows transforming into production investment. The investment of the host country at period *t* can therefore be specified as:

$$I_t = I_{dt} + \beta K_f = \varphi S_t + \beta K_F \tag{4}$$

In a capital inflow economic system, the total output can not only become the current period income but also be used to pay past international debts.

$$Q_t = Y_t + \alpha Q_t \tag{5}$$

where Y_t is the national income; α is the ratio of international debt payment (D_{Ft}) to total output in the current period, $0 \le \alpha = D_{Ft} / Q_t \le 1$. Let savings rate be a constant, then:

$$S_t = sY_t, (0 \le s \le 1) \tag{6}$$

From equation (5), we can derive

$$S_t = sQ_t(1-\alpha) \tag{7}$$

Substituting equation (7) into equation (4), we can get

$$I_t = \varphi s Q_t(1-\alpha) + \beta K_F \tag{8}$$

Taking the change of equation (5), the economic growth rate becomes:

$$g_t = dQ_t / Q_t = \Delta K_t / K_t = I_t / K_t - \delta = \varphi s Q_t(1-\alpha) / K_t + \beta K_F / K_t - \delta \tag{9}$$

Hence, the economic growth rate of the host country when there is capital inflow is:

$$g_t = A\varphi s(1-\alpha) + \gamma\beta - \delta \tag{10}$$

where $0 \le \gamma = K_F / K_t \le 1$ is the dependence on foreign capital, measured by the ratio of capital inflow to capital stock in the current period. The endogenous growth model in an open economy in this study is tested using equation (10) and $\gamma\beta = (K_F / K_t) \times (K_f / K_F) = K_f / K_t$ which is the ratio of investment rate by foreigners (FORN) and (1-α) is the ratio of foreign debt.

3.2 Econometric Model and Methods

3.2.1 VAR Theory

To ensure that all variables in the model have the causal relationship and to avoid the recognition problem in traditional simultaneous structural equations, Sims (1990) applies Vector Autoreg Ression (VAR) in econometrics. All variables in the model are lagged variables of itself and other variables. Extending the single variable autoregression to multi-variable vector autoregression can solve the exogenous variable problem as all variables become endogenous. They can be used to predict a relevant time series system and the dynamic impact on this system by random noises. The closed economy in this study is based on the AK model which has four variables, $y_{it}, y_{2t}, y_{3t}, y_{4t}$ (the real economic growth rate, capital formation rate, domestic financing rate and savings rate). Variable in time t is formed by the variable in the prior time period k and error term. For example, VAR (1) (i.e., k = 1) is as shown below:

$$\begin{aligned} y_{it} &= m_1 + a_{11}y_{1,t-1} + a_{12}y_{2,t-1} + a_{13}y_{3,t-1} + a_{14}y_{4,t-1} + \varepsilon_{1t} \\ y_{2t} &= m_2 + a_{21}y_{1,t-1} + a_{22}y_{2,t-1} + a_{23}y_{3,t-1} + a_{24}y_{4,t-1} + \varepsilon_{2t} \\ y_{3t} &= m_3 + a_{31}y_{1,t-1} + a_{32}y_{2,t-1} + a_{33}y_{3,t-1} + a_{34}y_{4,t-1} + \varepsilon_{3t} \\ y_{4t} &= m_4 + a_{41}y_{1,t-1} + a_{42}y_{2,t-1} + a_{43}y_{3,t-1} + a_{44}y_{4,t-1} + \varepsilon_{4t} \end{aligned} \quad (11)$$

where $E(\varepsilon_{it}) = 0, \forall i = 1,2,,3,4; Var(\varepsilon_t) = E(\varepsilon_t \varepsilon_t^{'}) = \sum, \forall t, E(\varepsilon_{it}\varepsilon_{is}) = 0, \forall t \neq s, i = 1,2,3,4.$ The error term ε_{it} is white noise. Based on this, we develop the causality test, impulse response analysis and forecast error variance decomposition analysis.

In order to understand the dynamic relationship between variables, this study further employs the variance decomposition function to find out which variable has stronger exogenous properties. That is, the volatility of each endogenous variable is decomposed into random errors in separate equations, where higher contribution means that the variable is more important. The vector autoregression model is: $BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \Gamma_2 X_{t-2} + ... + \Gamma_p X_{t-p} + \varepsilon_t$ where B is the parameter matrix, $X_t,\ldots,X_{t-p}$ is the variable matrix, and $\Gamma_0,...,\Gamma_p$ is the parameter matrix. This can be transposed into: $X_t = A^{-1}\Gamma_0 + A^{-1}\varepsilon$. Therefore, $A = B - \Gamma_1 L - \Gamma_2 L^2 - ... - \Gamma_p L^p$ where L is a lagged factor and A is a matrix consisted of multiple lagged factors, which forms the vector moving average (VMA) model, as shown below:

$$X_t = \alpha_0 + \varphi_0 \varepsilon_t + \varphi_1 \varepsilon_{t-1} + ... + \varphi_p \varepsilon_{t-p} + ... \quad (12)$$

where $\varphi_p = (\varphi_{p,ij})$ is a coefficient matrix with p = 0,1,…, and impulse on y_j is caused by the function $\varphi_{0,ij}, \varphi_{1,ij}, ...$

The Variance Decomposition Model used is this study is therefore as follows:

$$VC_{ij}(S) = \frac{\sum_{p=0}^{s-1}(\varphi_{p,ij})^2 \sigma_{ij}}{Var(y_{it})} = \frac{\sum_{p=0}^{s-1}(\varphi_{p,ij})^2 \sigma_{jj}}{\sum_{j=1}^{k}(\sum_{p=0}^{s-1}(\varphi_{p,ij})^2 \sigma_{jj})} \quad (13)$$

where $\varphi_{p,ij}$ is the Impulse Response Function. σ_{jj} is the standard deviation of component *j*'s white noise series. y_{it} is the component *i*'s Vector Autoregression (VAR). $VC_{ij}(S)$ is the variance contribution of component *j* on component *i*. This study then uses this method to decompose the impact of variables on the system and to determine how this variation impacts on other variables in the system.

3.2.2 Johansen Cointegration Test

Engle and Granger (1988) propose two steps of testing cointegration, which however cannot effectively handle multiple variables. An important function of VAR is to impose a restriction based on the cointegration relationship to examine the long-term dynamic relationship between variables. Johansen (1988, 1991) proposes a multivariate VAR (P) cointegration test:

$$Y_t = C + \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + ... + \Pi_p Y_{t-p} + U_t \quad (14)$$

where $Y_t = (y_{1t} ... y_{nt})'$ with the assumption $Y_t \sim I(1)$. After adjustments, VAR (P) in model (2) can be represented as:

$$\Delta Y_t = C + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 Y_{t-2} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + \Omega Y_{t-p} + U \quad (15)$$

where $\Gamma_i = -I + \Pi_1 + ... + \Pi_i, i = 1...p$, and $\Omega = -I + \Pi_1 + ... + \Pi_p$. All terms in equation (15) are stationary except for ΩY_{t-p}. Hence, same as VAR (1), reducing the matrix Ω before vector Y_{t-p} can be used to test the cointegration relationship between variables. If the rank of coefficient matrix Ω is $rk\Omega = r < n$, there exist vectors α and β $(n \times r)$ with rank *r*. Therefore, $\Omega = \alpha\beta'$ and $\beta' Y_{t-p}$ is stationary with $\beta' Y_{t-p} \sim I(0)$. β is a cointegrated variable matrix reflecting long-term relationship between variables. α is an adjusted coefficient matrix reflecting the short-run adjustments in variables between this period and last period's disequilibrium. Johansen cointegration test can be carried out in two ways. First, the trace test which can be calculated as follows:

$$LR_r = -T * \sum_{i=r+1}^{n} Ln(1 - \lambda_i) \quad (16)$$

where λ_i is the eigenvalue of a matrix produced during the calculation.

Secondly, the maximum eigenvalue test, which is calculated as follows:

$$LR_{\max} = -T * Ln(1 - \lambda_r) \quad (17)$$

where λ_i is the largest eigenvalue. Based on the characteristics of the time series (that is, whether there is a trend or second order), cointegration equation and VAR model can derive five possible situations. They can then all use Johansen cointegration Likelihood Ratio (LR) to conduct the tests.

3.2.3 Error Correction Model

While the economic variables in time series model may exist a long-run equilibrium, in a short period of time, such equilibrium may not exist. The error in one period may be corrected in the next period. This suggests that the cointegration between variables is related to equilibrium adjustment and error correction. According to Granger Representation Theorem of Engle and Granger, when a long-run cointegration relationship exists in time series, there must exist an error correction model between the time series. In other words, series with error correction model must have cointegration relationships.

If Y_t and $X_t \sim I(0)$, the lagged autoregression model of rank (1, 1) is as follows:

$$Y_t = \alpha + \beta Y_{t-1} + \delta_0 X_t + \delta_1 X_{t-1} + \varepsilon_t \quad , \quad |\beta| < 1 \quad , \quad \varepsilon_t \sim IID(0,\sigma^2) \tag{18}$$

where ε_t does not exist autocorrelation. The long-term relationship of Y_t and X_t is:

$Y_t = \gamma + \lambda X_t$ where $\gamma = \frac{\alpha}{1-\beta}$ and $\lambda = \frac{\alpha_0 + \alpha_1}{1-\beta}$. From equation (18), we can get:

$$Y_t - Y_{t-1} = \alpha + \beta Y_{t-1} - Y_{t-1} + \delta_0 X_t - \delta_0 X_{t-1} + \delta_0 X_{t-1} + \delta_1 X_{t-1} + \varepsilon_t$$

which can be rearranged as:

$$\Delta Y_t = \delta_0 \Delta X_t + (\beta - 1)(Y_{t-1} - \gamma - \lambda X_{t-1}) + \varepsilon_t \tag{19}$$

The above equation is the error correction model. $(\beta - 1)(Y_{t-1} - \gamma - \lambda X_{t-1})$ is the error correction term and $(Y_{t-1} - \gamma - \lambda X_{t-1})$ is the non-equilibrium error of the prior period. The equation (19) shows that if Y_t is stationary, then $|\beta| < 1$ and $(\beta - 1)$ is negative. This shows that the error correction term has an inverse correction effect on ΔY_t. When the prior period's Y_{t-1} relative to the equilibrium is higher (or lower) and the inverse correction effect of the error correction term is in place, this period's ΔY_t will become lower (or higher). Y_t will move towards the equilibrium. The inverse correction property of the error correction term is the result of a regular economic pattern. $(\beta - 1)$ represents the correction speed of error correction term on ΔY_t. $(Y_{t-1} - \gamma - \lambda X_{t-1})$ denotes the long-term relationship between Y_t and X_t. $\Delta Y_t = \delta_0 \Delta X_t + (\beta - 1)$ is the short-term relationship between Y_t, X_t and the error correction term.

3.3 Experimental Design and Estimation Methods

Based on the concept of program trading (Williams, 1999), we include the reference target data (data1) and two more sets of data (data2 and data3) as filters to increase the trading performance. Data1 is the TAIEX futures; data2 is the closed position of three main institutional investors (including dealers, investment trusts and foreign institutional investors); data3 is the data on securities lending by foreign institutional investors.

The trading strategies of buying (or selling) threshold are as follows: (1) the closing price of data2 is higher (or lower) than the 20-day closing price moving average of data2; (2) the closing price of data1 is higher (or lower) than the 20-day closing price moving average of data1 and the closing price of data3 is higher (or lower) than the best-buy (or best-sell) threshold of RSI. Note that the two conditions must be met at the same time for the trading action to be taken. The transaction fee is set at \$1000 and this study does not consider other transaction costs or the changes in price after making a buy or sell order. The position is closed out if the profit is greater than 500 points or the loss is greater than 100 points.

Based on the real market trading results, two stages of tests are taken to examine how investors can consistently make profits in the Taiwan stock market. First, we use program trading to simulate the optimal trading. In the second stage, we use the coefficients from the optimal model in stage 1 and the Taiwan stock market data to do the test. Moreover, this study uses the optimal MultiCharts[5] program trading to conduct back-testing. Comparing with the optimal trading performance (that is, the best buy or sell threshold of RSI and the 20-day closing price moving average), we can see if adding external

information (i.e., the securities lending data of foreign institutional investors) to the existing information on the close position of three main institutional investors can enhance the trading performance in the futures market based on the technical analysis.

4. Data

This study analyses the impact of financial liberalizations of foreign investors on Taiwan economy. The sample period covers from the first quarter of 2001 to the first quarter of 2015. Using quarterly data, the final sample size is 57. The data are obtained from Taiwan Economic Journal (TEJ), including real economic growth Rate (G), Gross Domestic Product (GDP), growth capital formation (K) domestic Savings (S), total domestic financing (FUND, including stock and bond market), depreciation (DEPR2040 simplified as DEPR), foreign DEBT (DEBT) ratio, and Foreign Investment Ratio (FORN). The AK model is then calculated based on the definitions used in Pagano (1993) and Murinde (1996). In this study, the capital output ratio is measured by a capital-output coefficient (KGDP = K/GDP, also called as capital formation rate). The ratio of savings transforming into investment is measured by the ratio of financing in the capital market to savings (FUNDS = FUND/S, also called as domestic savings rate). Depreciation rate is defined as Taiwan's nominal fixed capital consumption allowance to capital stock. As there is no official data on capital stock, it needs to be calculated. This study uses the total of gross Taiwan nominal capital formation on constructions (where the usage is limited to 40 years) since 1970 and other gross Taiwan formation (where the usage is limited to 20 years) since 1990 minus Taiwan nominal fixed capital consumption allowance. This value is then deflated by the capital product index of Taiwan industrial production index (2011 = 100). Foreign debt ratio is based on Taiwan public foreign debt ratio provided by TEJ. Due to Taiwan's special diplomatic position, Taiwan does not provide data on government debt. In this study, we use the debt issued by companies as a proxy and as a result, this ratio becomes relatively small; the average for the whole sample period is 2.07%. Foreign investment ratio is measured by the foreign direct investment in the balance of payment divided by capital stock.

This study also adopts model data from Lan et al. (2012). Data1 is the data on TAIEX futures (60-min trading information). Data2 is the unclosed position (daily data) of three main institutional investors (including dealers, investment trusts and foreign institutional investors). Data3 is the daily securities lending data of foreign institutional investors. The sample period is also divided into two stages. The first stage covers from July 1, 2007 to August 10, 2010. The second stage covers from July 1, 2007 to August 10, 2013.

5. Empirical Results

5.1 Unit Root Test of VAR Model Variables

To ensure the validity of the results, we need to test if the time series are stationary. The VAR model test requires us to choose SC (KPSS) with the minimum value. The results show that at level, the

intercept and trend reject the null hypothesis (Table 1). Capital formation rate, savings rate, foreign debt ratio and foreign investment ratio at the lag period equaling to zero, the SC is at the lowest. Real economic growth rate (G) at the lag period = 2 has the minimum SC. Domestic financing rate (FUNDS) at lag period = 4 has the minimum SC. Therefore, variables are relatively stable at level. In other words, I (0) is a stationary series and we can proceed with the VAR test.

Table 1. Unit Root Test of VAR Model Variables

Unit Root Test	Augmented Dickey-Fuller		Kwiatkowski-Phillips-Schmidt-Shin	
Variable / Model	Intercept	Intercept and Trend	Intercept	Intercept and Trend
G	-5.2860 (2)*	-5.3130 (2)*	0.0571***	0.0572***
KGDP	-4.8580 (0)*	-4.4357 (0)*	0.1506***	0.1489*
FUNDS	-1.8502 (5)	-4.3347 (4)*	0.9256	0.0636***
SGDP	-2.5922 (1)***	-6.1453 (0)*	0.7584	0.0732***
DEBT	-3.6103 (0)*	-3.5517 (0)**	0.2009***	0.1868*
FORN	-6.4549 (0)*	-6.4549(0)*	0.1312***	0.0712***
DEPR	-4.7934 (0)*	-6.6182 (0)*	0.4513**	0.1197**

According to McKinnon (1973), * represents 1% significant level. G, KGDP, FUNDS, SGDP, DEBT, FORN, DEPRFORN and DEPR are real economic growth rate, capital formation rate, domestic financing rate, savings rate, foreign debt ratio and foreign investment ratio, respectively. (0) shows that the lag period is 0 with the minimum SC.

5.2 Causality Test of VAR Model

As all the variables are endogenous, we can proceed with the VAR model estimation. Owing to the limitation of sample size, this study uses lagged one period with minimum SC (Table 2). Hence, in the next section, these seven variables will be included in the model and preceded with VAR model testing to analyze the causality effect. The Granger causality test results of the Taiwan AK model is presented in the Appendix.

Table 2. Lagged Period Estimation of VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	455.2124	NA	1.06e-16	-16.91368	-16.65345	-16.81360
1	666.3262	358.4951	2.38e-19	-23.03118	-20.94936*	-22.23061
2	714.0075	68.37328	2.76e-19	-22.98142	-19.07801	-21.48035
3	787.8017	86.32529	1.41e-19	-23.91705	-18.19205	-21.71549
4	882.3760	85.65216*	4.44e-20*	-25.63683*	-18.09024	-22.73478*

The coefficient of variables from the VAR model estimation can reflect the impact of short-term volatility on the short-term volatility of the explanatory variable. Capital formation rate, savings rate, domestic financing rate and foreign investment ratio all lead the real economic growth rate by one period. Savings rate and capital formation rate, savings rate and domestic financing rate, and capital formation rate and foreign debt ratio all lead each other by one period. Domestic financing rate and depreciation rate both lead savings rate by one period. Depreciation rate also lead real economic growth rate by one period. The results suggest that in the short-term, real economic growth rate leads other variables (please refer to the following matrix).

$$ly_t = \begin{bmatrix} 0.742* & -31.637 & 0.255 & 15.520 & 0.104 & 28.953 & -184.34 \\ 0.004* & 0.127 & 0.006 & -0.332 & -0.002 & 0.008 & 0.317 \\ -0.039* & 1.688 & 0.627* & 11.465* & -0.016 & -2.934 & 9.206 \\ 0.003* & -0.327 & 0.020* & 0.095 & 0.000 & -0.075 & 0.003 \\ 0.040 & -32.006* & -0.380 & 2.395 & 0.443* & 7.185 & 45.053 \\ 0.000 & -0.083 & 0.000 & 0.000 & -0.0803 & 0.008 & 0.294 \\ 0.000 & -0.01 & 0.002 & 0.032 & 0.000 & 0.000 & 0.572* \end{bmatrix} * ly_{t-1} + \begin{bmatrix} -2.246 \\ 0.516 \\ -1.091 \\ 0.360 \\ 60.922 \\ 0.062 \\ 0.008 \end{bmatrix}$$

where $ly = \begin{bmatrix} G & KGDP & FUNDS & SGDP & DEBT & FORN & DEPR \end{bmatrix}'$ and some coefficients are significant at the 1% level (presented by an asterisk), showing that there possibly exists causality relationships between variables. The Granger causality estimation results are presented in the Appendix Table 1.

5.3 Variance Decomposition Analysis

Based on the variance decomposition analysis, the effect on real economic growth rate mostly comes from itself. The contribution weighs at about 99.95% (Table 3). The capital formation rate, domestic financing rate, savings rate are strongly affected by the real economic growth rate. The contribution weighs at about 24.33%, 32.32%, 30.10%, respectively. Savings rate are also affected by capital formation rate and domestic financing rate by about 20.04% and 32.80%, respectively. While other variables have smaller effects, they are also consistent with the economic theories.

Table 3. Variance Decomposition Analysis Results

Variance Decomposition of G:								
Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	3.026259	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	6.126523	99.95771	0.012792	0.014985	0.005001	0.004435	0.004461	0.000615
8	8.675225	99.95633	0.013209	0.015474	0.005164	0.004580	0.004607	0.000636

Variance Decomposition of KGDP:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.016226	0.619523	99.38048	0.000000	0.000000	0.000000	0.000000	0.000000
4	0.032833	22.31899	52.75294	12.66338	4.226445	3.748036	3.770081	0.520126
8	0.045605	24.33179	48.91733	13.58937	4.535495	4.022104	4.045760	0.558159

Variance Decomposition of FUNDS:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.275915	10.33095	0.000787	89.66826	0.000000	0.000000	0.000000	0.000000
4	0.544670	30.11937	3.850207	61.55386	1.542634	1.368017	1.376063	0.189844
8	0.763840	32.32786	4.046200	58.91322	1.624014	1.440185	1.448656	0.199859

Variance Decomposition of SGDP:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.017441	2.789336	1.891166	72.89147	22.42803	0.000000	0.000000	0.000000
4	0.034679	27.45337	18.28157	36.50827	10.90144	3.196481	3.215281	0.443585
8	0.048215	30.10469	20.04864	32.80996	9.693861	3.423793	3.443931	0.475130

Variance Decomposition of DEBT:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.016226	0.619523	99.38048	0.000000	0.000000	0.000000	0.000000	0.000000
4	0.032833	22.31899	52.75294	12.66338	4.226445	3.748036	3.770081	0.520126
8	0.045605	24.33179	48.91733	13.58937	4.535495	4.022104	4.045760	0.558159

Variance Decomposition of FORN:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.011387	0.025872	7.911849	1.309933	0.119913	0.512906	90.11953	0.000000
4	0.023043	1.624623	12.95375	4.205038	0.114333	1.452464	79.60872	0.041075
8	0.032579	1.704096	13.46154	4.449947	0.089857	1.534280	78.71773	0.042543

Variance Decomposition of DEPR2040:

Period	S.E.	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR2040
1	0.003552	0.175275	0.717267	1.077019	4.982042	0.180883	0.004466	92.86305
4	0.007121	0.280424	0.576620	0.888264	5.207007	0.227458	0.015027	92.80520
8	0.010073	0.290550	0.560791	0.867155	5.231025	0.232195	0.015893	92.80239

Note. Cholesky Ordering: G KGDP FUNDS SGDP DEBT FORN DEPR2040.

5.4 Cointegration Test

Johansen cointegration test of AK model shows that Trace test and Max-Eigen value have five and four cointegration relationships, respectively (Table 4). This study uses AIC and chooses CE of the second category, that is, without fixed trend but with an intercept term in VAR.

Table 4. Johansen Cointegration Test Results of Taiwan AK Model

	Trace			Max-Eigen		
Eigenvalue	Test hypothesis	Statistic value	5% critical value	Test hypothesis	Statistic value	5% critical value
0.799529	r = 0*	251.1813	134.6780	r = 0*	89.99666	47.07897
0.537245	r< = 1*	161.1846	103.8473	r< = 1*	43.15123	40.95680
0.535662	r< = 2*	118.0334	76.97277	r< = 2**	42.95997	34.80587
0.490105	r< = 3*	75.07339	54.07904	r< = 3*	37.71887	28.58808
0.264245	r< = 4*	37.35452	35.19275	r< = 4	17.18404	22.29962
0.215033	r< = 5	20.17048	20.26184	r< = 5	13.55833	15.89210

5.5 Error Correction Model

The error correction model shows that in the long-run, capital formation value (coefficient = 162.5447), savings rate (coefficient = 111.7681) and foreign investment rate (coefficient = 98.61681) are positively related to real economic growth rate (Table 5). Domestic financing rate (coefficient = 1.812480), foreign debt ratio (coefficient = 0.83) and depreciation rate (coefficient = 115.9627) are significantly related to real economic growth rate at the 10% level. The short-term domestic financing rate has coefficient of -0.0423 and t-value of -4.48805. The result meets the requirement of a short-term divergence and long-term convergence in the error correction model and shows a good fit of the model. The equation of the error correction model can be presented as follows:

G (-1) = -141.1013 + 162.5447 KGDP (-1) + 111.7681 SGDP (-1) -1.812480 FUNDS (-1)

[-6.65406] [10.1586] [7.11185] [-2.99437]

+ 0.83(1-DEBT) + 98.61681 FORN (-1)-115.9627 DEPR2040 (-1)

[4.17483] [2.90931] [-1.90994]

The results show that capital formation, domestic savings and foreign direct investment are beneficial to Taiwan's economic growth. However, domestic financing rate, foreign debt ratio and depreciation rate are detrimental to Taiwan's economic growth, especially the domestic financing rate. Domestic financing includes stock and bond markets. The characteristic of financial liberalization is that there is no capital restriction. International capital can freely flow to other countries and invest in their stock markets. Since the 21st centuries, the foreign institutional investors represent almost 38% of the Taiwan stock market and have great importance. However, part of the evidence from this study shows that foreign institutional investors are harmful to Taiwan's economic growth, thereby inconsistent with the

hypothesis that financial liberalization is totally beneficial to economic growth.

Furthermore, based on the Balance Of Payment (BOP) provided by IMF, balance of payment has five accounts, current account, capital account, financial account, balancing items and foreign reserves. The first two accounts are the main ones. Financial accounts can be divided into Foreign Direct Investment (FDI), securities investment, and other investment. At balance, current account and financial account should be equal (X-M = FDI + FPI + FOI). This study finds that Savings (S) and Financing (FUNDS) have Granger causality relationship. Hence, this study combines the current account and financial account of BOP and further estimates the following model:

$$S = I + FDI + FPI + FOI \quad (20)$$

The estimation results of the error correction model shows that from the long-term, foreign securities investment (coefficient = 0.00017) and financing rate are positively related. Other foreign investment (coefficient = -0.0000541) and financing rate are negatively related and are significant at the 10% level. Foreign direct investment and financing rate are negatively related but the result is insignificant. Other short-term foreign investment (coefficient = -5696.559; t-value = -9.2066) also meets the requirement of a short-term divergence and long-term convergence in the error correction model and shows a good fit of the model. The equation of the error correction model is presented below:

FUNDS (-1) = 2.9022 + 0.0496 Trend + 0.00017 FPI(-1)-5.41E-05 FOI(-1)-0.00016 FDI(-1)

[4.6027] [6.5785] [-2.4492] [-1.2441]

Therefore, foreign securities investment is beneficial to the financing rate in Taiwan. However, other foreign investments (including hot money) are detrimental to the financing rate in Taiwan. In other words, this study indirectly proves that the hot money in the stock market is not good for Taiwan's economic growth. The results of variance decomposition analysis of BOP model is presented in the Appendix (Table 1, 2 and Figure). It shows that FOI also causes the disturbance of the stock price of Taiwan. Therefore, this study does not fully support the hypothesis that foreign capital inflow is beneficial to Taiwan's economic growth.

5.6 Total Trade Analysis of Three Institutional Investors Using TAIEX Futures Program Trading

The above evidence shows that foreign institutional investors represent about 40% of the capital in the Taiwan stock market while they are detrimental to Taiwan's economic growth. This leads to our second research question: "How can investors survive under such condition since it is impossible for Taiwan to completely withdraw from financial liberalization, which is the current global trend?"

This study follows the program trading experimental design used in Lan et al. (2012). Data1 is the TAIEX futures; data 2 is the closed position of three main institutional investors (including dealers, investment trusts and foreign institutional investors); data 3 is the data on securities lending by foreign institutional investors. The sample period is divided into two stages. The first stage covers from July 1, 2007 to August 10, 2010. The second stage covers from July 1, 2007 to August 10, 2013. We aim to compare the trading performance when three institutional investors are used as the filter.

The results[6] show that during the 36-month period (from July 1, 2007 to August 10, 2010), the TAIEX

falls from 8903 to 3955 and bounces back to 7976. The investment portfolio of dealers has traded for 55 times and makes a profit of $715,000. Having the optimal coefficient, the simulation period is then extended to August 10, 2013. The TAIEX falls to 7856. In these two stages, the index falls by a total of 11.76%. The net profit of dealers' investment portfolios increases to $882,000, showing a rise of 23.3%. The investment portfolio of investment trusts have traded for 61 times, making a gain of $311,000. Extending the simulation period to August 10, 2013, the number of trading increases to 113 times, and the trading profit increases slightly to $318,000. The trading profit of foreign institutional investors' investment portfolio shows an increase of 103.5% from $796,000 in the first stage to $1,620,000 in the second stage. The results show that the securities lending information of foreign institutional investors can increase trading performance (Table 5). The results again show that Taiwan's futures market is not strong-form market efficient and provide support to our hypothesis that the investment efficiency of foreign institutional investors is better than domestic institutional investors. Investors can increase their investment performance by following the trading strategies of foreign institutional investors.

Table 5. Total Trade Analysis of Taiwan Three Institutional Investors Using Taiex Futures Program Trading

	2007.7.1~2010.8.10			2007.7.1~2013.8.10		
Institutional investors	Net profit ('000)	Transaction (number of times)	Winning probability (%)	Net profit ('000)	Transaction (number of times)	Winning probability (%)
Dealers	71.5	55	43	88.2	127	42
Investment trusts	31.1	61	36	33.8	113	39
Foreign investors	79.6	53	47	162	121	47

6. Conclusion

This study uses Taiwan data from the first quarter of 2001 to the second quarter of 2015 to examine if foreign capital inflows are beneficial to Taiwan's economic growth. In addition, this study uses program trading to show that with financial liberalization the investment efficiency of foreign investors is better than domestic investors.

The error correction model shows that capital formation, domestic savings rate and foreign direct investment are positively related to real economic growth. However domestic financing rate, foreign debt ratio and depreciation rate are significantly negatively related to real economic growth. Adopting the analysis of BOP, these results also prove that as some of foreign capital inflows are hot money, they are not good for developing countries. Therefore, this study finds evidence does not fully support the hypothesis that foreign capital inflow to the stock market is beneficial to economic growth.

In this case, how to use the information of foreign capital inflows are essential to financial operations.

This study shows that Taiwan futures market is not strong-form market efficient. The investment efficiency of foreign institutional investors is better than domestic institutional investors. Therefore, investors can increase investment performance by following the investment strategies of foreign institutional investors. The implication from this study is that emerging countries may consider a certain level of financial protection using, for example, Tobin tax (Tobin, 1974) to avoid the history repeating itself like what happened in Chile in the 1990s[7]. Future studies could examine other financial tools in the market, use different sample periods or conduct a back-testing simulation using optimal coefficient.

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Appendix

Appendix 1. Granger Causality Estimation Results of Taiwan's AK Model

Granger cause /Granger results	G	KGDP	FUNDS	SGDP	DEBT	FORN	DEPR
G	--	2.1230 0.1451	0.1009 0.7507	0.4947 0.4818	0.1614 0.6879	0.4216 0.5161	5.2750** 0.0216
KGDP	43.9491* 0.0000	--	1.8222 0.1771	7.0364* 0.0080	3.2619*** 0.0709	0.0011 0.9728	0.4848 0.4862
FUNDS	16.7804* 0.0000	0.890411 0.3454	--	39.771* 0.0000	0.6156 0.4327	0.6380 0.4244	1.9379 0.1639
SGDP	33.7554* 0.0000	7.1755* 0.0074	21.139* 0.0000	--	0.3953 0.5295	0.0913 0.7624	7.51E-05 0.9931
DEBT	0.5820 0.4455	10.8496* 0.0010	1.1161 0.2907	0.058839 0.8083	--	0.1296 0.7188	1.5733 0.2097
FORN	6.4526** 0.0111	1.4244 0.2327	0.0910 0.7628	3.74E-05 0.9951	0.4720 0.4920	--	1.3099 0.2524
DEPR	0.6685 0.4136	0.2630 0.6080	6.4153** 0.0113	2.1920 0.1387	0.2041 0.6514	0.0001 0.9889	--

Note: 1.The definitions of the variables are as provided in Table 1. The numbers represent F-value (above) and P-value (below).

* represents 1% significant level.

** represents 5% significant level.

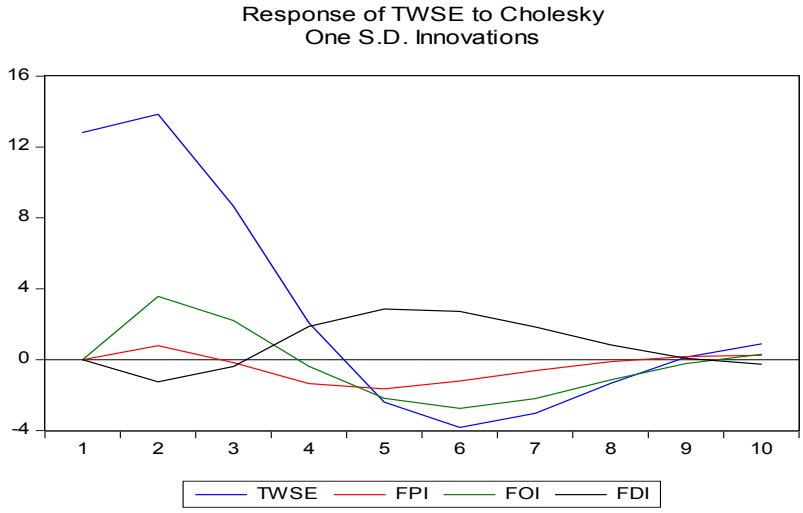
2. The results show that depreciation rate is the Granger cause of real economic growth rate. Real economic growth rate, domestic savings and foreign debt ratio are the Granger cause of capital formation. Real economic growth rate and domestic savings are the Granger cause of domestic financing rate. Real economic growth rate, capital formation and domestic financing rate are the

Granger cause of domestic savings. Kapital formation is the Granger cause of foreign debt ratio. Real economic growth rate is the Granger cause of foreign investment ratio. Domestic financing rate is the Granger cause of depreciation rate.

Appendix 2. Statistics of BOP and TWSE

	FPI	FOI	FDI	TWSE
Mean	-4997.18	3006.754	-1524.11	4.201404
Median	-5496	2576	-1460	7.64
Maximum	6699	16606	1178	68.27
Minimum	-22355	-8473	-4834	-47.38
Std. Dev.	6050.23	6452.413	1157.784	23.30459
Skewness	-0.43454	0.131963	-0.40631	-0.02554
Kurtosis	2.9439	2.283145	3.082511	3.929085
Jarque-Bera	1.801327	1.385902	1.584487	2.056293
Probability	0.4063	0.500098	0.452828	0.357669

Appendix 3. Impulse of Response of TWSE to BOP



Notes

Note 1. http://www.epochtimes.com/b5/7/6/27/n1755971.htm.

Note 2. http://stockq.cn/market/.

Note 3. Source: Balance of Payments, CBC.

Note 4. Refer to Murinde (1996) and Zhang (2010).

Note 5. Please refer to http://www.multicharts.com.

Note 6. Lan et al. (2012) shows that Taiwan's futures market is not strong-form market efficient. Using

securities lending information of foreign institutional investors, the trading becomes more efficient. The data of this study and Granger causality test methods are the same. Due to page limit, they are not presented here. The unclosed position data of three institutional investors started from July 1, 2007.

Note 7. Between 1990-1998, Chile government adjusted capital flow tax to restrict excessive capital inflow in 1995 and to attract capital in 1998. This method is beneficial to counter-cyclical adjustment of capital flow. Many studies have reported that this method has turned short-term loan into long-term trade and does not reduce the overall capital inflow in Chile. On the contrary, this tax method has helped reach the expected outcome of the government policy (Liu, 2009).