Conditional and Unconditional Causality Relations Between Taiwan and International Capital Markets

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Abstract

This paper examines the conditional and unconditional causality relations between Taiwan and international capital markets, including the U.S., the U.K., the Japanese, and the Hong Kong markets for the period of 1982-1992. We intend to divide the whole period into two subsamples, 1982:1-1987:10/18 (the pre-crash period) and 1987:10/20-1992:12 (the post-crash period). A multiple hypotheses testing method is employed to identify pairwise causal relations. The testing method allows us to systematically examine all relevant hypotheses regarding the dynamic relations between Taiwan and international capital markets. We document a feedback relation, under the condition of the U.S. effect, between Taiwan and international capital markets. It implies the integration of Taiwan and international capital markets. In examining the unconditional causality relations between markets, we find an independent relation and a contemporaneous relation between markets in the pre-crash period and in the post-crash period, respectively. It shows the integration of Taiwan and international capital markets after the October Crash in 1987.

Keywords: Conditional Causality, Unconditional Causality, International Capital Markets

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1. Introduction

The issue of international capital market integration and transmission has received a great deal of attention recently. It also lies behind much of the recent international investment and policy discussion. Studies by Hilliard [1979], Eun and Shim [1989], and Campbell and Hamao [1992] find evidence of positive correlations in returns across individual stock markets. However, the intercorrelation among markets is low on average and varies quite sharply across countries [Eun and Shim, 1989; Roll, 1992]. The U.S. stock market is found to be most influential in terms of its effect on foreign market performance.

The international financial markets are linked by the international information network system. Financial information travels, no matter when it is day or night, around the world. Investors in different time zones frequently transmit important financial information from one market to another. A shock in one market may cause a reaction in other markets. The integration of international capital markets has changed investors strategies. Investors have to understand the relationships between markets, including leads and lags returns and spillovers, before they make an international investment decision. Open economy is a common feature in industrial countries. The capital markets in a country have to absorb many impacts from other countries. A contrarian investment strategy, developed by Lo and MacKinlay [1990], provides an opportunity for domestic investors to make excess returns by using the systematic lead-lag returns relations between stocks. The lead-lag relationship between international markets has been an important issue in financial research after the October 1987 crash since Eun and Shim [1989], Fischer and Palasvirta [1990], Hamao, Masulis and Ng [1990] and Campbell and Hamao [1992] reach the same conclusion that the U.S. market is the "leading" market.

In this study, we identify the unconditional causality relations between Taiwan and international capital markets. The empirical results may help us to develop a contrarian strategy on international investments. We have special interest in examining the structure change between market return relations based on the common belief that international capital market was getting integrated after the October crash 1987. Furthermore, we also identify the conditional causality relations between Taiwan and international markets by isolating the dominant effect from the U.S. market.

The rest of this study is organized as follows. Section 2 discusses the causality relations among international capital markets. A multiple hypothesis approach for testing the conditional and unconditional causality relations between markets is discussed in section 3. The data description and empirical results are provided in section 4 and 5, respectively. Section 6 is the conclusion.

2. The causality relations among international capital markets

The issue of the international market integration has drawn a great deal of attention since the October 1987 market crash. Some studies support the theory of international market integration while others find segmented markets. In investigating the causality relations, Campbell and Hamao [1992] find that the U.S. market is a leading market. The level of the Japanese dividend/price ratio relative to the U.S. dividend/price ratio can be used to predict the Japanese market returns.

In addition to examining the long-term equilibrium relationship, it is also important to investigate the short-term transmission between international capital markets. Eun and Shim [1989] found that the innovations in the U.S. market rapidly transmitted to other markets but no single foreign market explained the U.S. market. Fischer and Palasvirta [1990] employed a different method in analyzing the interdependency of international markets. They measure the covariance relationship between two joint stationary stochastic process X_{it} and X_{jt} at frequency ω. If $0 \leq |\omega_{ij}| \leq 1$ then interdependency exists. Their findings suggest the U.S. is a worldwide "lead" market and the U.S. index causes variations in the other indices. By examining different periods, they find that the level of interdependency has increased substantially from 1986 to 1988. This implies that the integration of international markets has become more significant after the crash of October 1987. Their finding of a consistent lead-lag relationship also suggests a potential arbitrage opportunity.

The lead-lag return relationship between international capital markets may give arbitragers an opportunity to earn an excess return. An arbitrage strategy for an international portfolio was proposed by Solnik [1983]. He argued the world market portfolio was not optimal in the sense that investors would hold different portfolios, especially "hedge" portfolios. Lo and MacKinlay [1990] constructed a contrarian portfolio by selling the "winners" and buying the "losers" and found a significant positive excess weekly returns crediting to cross-autocorrelation and own-autocorrelation in the U.S. market. Such abnormal returns may also exist in foreign markets.

Schwert [1989] analyzes the relations of stock volatility with the volatilities of real and nominal macroeconomic variables. Although he cannot find significant relations between stock volatility and nominal macroeconomic variables volatilities, he finds that the volatility of real economic variables is a major determinant of stock returns volatility.

Theoretically, in an integrated international capital market, investors are assumed to have a homogeneous expectation of returns process no matter which market they are in. Based on the same information set, international investors tend to choose the international market portfolio. In equilibrium, each stock in international capital markets has an equilibrium asset pricing. Under the assumption of a complete international capital market, the equilibrium asset may be priced by a single international market portfolio as proposed by Stulz [1980]. In addition, the equilibrium asset pricing in an international capital market may be explained by a subset of international macroeconomic variables. This is the proposition of Roll [1992], and Campbell and Hamao [1992].

However, in the short run, international investors may not have the same information set. They may form the hedge portfolio and possess heterogeneous expectations of returns [Solnik, 1983]. Heterogeneous expectations may result from several sources. The most important is the geographic reason. International investors do not trade in an international stock exchange. Instead, they trade in their own capital market. Nonsynchronous trading hours count for the heterogeneous information set and heterogeneous expectations. A major event, such as a political event, may result in a nonsynchronous impact to different markets. Some markets get the information during the trading hours. Other markets are closed when the world information are released. The impact of this event to a market may cause another impact to others, resulting in the lead-lag return relations.

Some other reasons such as the regulations of cash inflow and outflow may also account for the heterogeneous expectations of international investors. Roll [1992] shows that the deregulation of Japanese capital market results in the integration of international capital markets. Mutual fund investment across the international markets may also contribute to the international capital markets integration.

According to the argument of Lo and MacKinlay [1990], large firms typically lead small firms. The fully disclosed information and the frequent trading of large firms relative to small firms may cause the lead-lag returns relations. The situation can be applied to the international markets. Large markets release much more information to the international investors than small markets do. For example, NYSE is a typical leading market among international markets. The trading data of NYSE are accessible around the world. It also creates the largest trading volume in the world. In reality, the U.S. market is the leading market among the international capital markets, see Eun and Shim [1989] and Campbell and Hamao [1992].

Another concern is the more integrated international capital markets after the crash in October 1987. An integrated international market will have a more complex information flow situation. That is, the information may flow in a two-way instead of a one-way situation. A large market may directly affect a small market. This implies a unidirectional leading relation between these two markets. A small firm may not affect a large market, or the influence is insignificant. However, in an integrated international capital market, the influence is two-way. A feedback relation may be found in these two markets. Therefore, information flows explain different relations.

Economic influence is another reason for the complicated situation. Owing to the growth of international trades and investments, international capital market reflects the impact of a country's economic policy more rapidly. A unexpected change in monetary policy or a change of foreign exchange rates in a country may cause a feedback from other countries.

The common belief of more integrated international capital markets after the October crash suggests that lead-lag relations becomes more significant. The anticipated returns relation is a unidirectional relation from a large market to a small market in the pre-crash period. However, the relation may be changed to a feedback relation in the post-crash period.

3. Empirical Methodology

Consider the following bivariate VAR model:

$$\begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \qquad (1)$$

where x_{1t} and x_{2t} are mean adjusted variables. The first and second moments of the error structure, $\underset{\sim}{\varepsilon}_t = (\varepsilon_{1t}, \varepsilon_{2t})'$, are that $E(\underset{\sim}{\varepsilon}_t) = \underset{\sim}{0}$, and $E(\underset{\sim}{\varepsilon}_t \ \underset{\sim}{\varepsilon}'_{t+k})$ for $k \neq 0$ and $E(\underset{\sim}{\varepsilon}_t \ \underset{\sim}{\varepsilon}'_{t+k}) = \Sigma$ for $k = 0$, where

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}$$

The autoregressive component of the model is specified in terms of polynomials,

$$\phi_{ij}(L) = \sum_{k=0}^{r_{ij}} \phi_{ij}(k) L^k$$

where L is a backshift operator. The leading coefficient of this polynomial is equal to unity if $i = j$ and zero if $i \neq j$; i.e., $\phi_{ij}(0) = \delta_{ij}$ in the Kronecker delta notations.

Following the concepts advanced in Granger (1969), we can define four relations between two random variables, x_1 and x_2, in terms of constraints on the conditional variances of $x_{1(T+1)}$ and $x_{2(T+1)}$ based on various available information sets, where, $\underset{\sim}{x}_i = (x_{i1}, x_{i2}, \cdots, x_{iT})'$, are vectors of observations up to time period T.

Definition 1, Independency, $x_1 \wedge x_2$: x_1 and x_2 are independent if and only if

$$Var\left(x_{1(T+1)} \mid \underset{\sim}{x}_1\right) = Var\left(x_{1(T+1)} \mid \underset{\sim}{x}_1, \underset{\sim}{x}_2\right) = Var\left(x_{1(T+1)} \mid \underset{\sim}{x}_1, \underset{\sim}{x}_2, x_{2(T+1)}\right) \qquad (2)$$

and

$$Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_2) = Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) = Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2, x_{1(T+1)}). \qquad (3)$$

Definition 2, Contemporaneous Relation, $x_1 \leftrightarrow x_2$: x_1, and x_2 are contemporaneously related if and only if

$$Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1) = Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) \qquad (4)$$

$$Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) > Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2, x_{2(T+1)}) \qquad (5)$$

and

$$Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_2) = Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) \qquad (6)$$

$$Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) > Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2, x_{1(T+1)}). \qquad (7)$$

Definition 3, Unidirectional Relation, $x_1 \Rightarrow x_2$: There is a unidirectional relation from x_1 to x_2 if and only if

$$Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1) = Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) \qquad (8)$$

and

$$Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_2) > Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) \qquad (9)$$

Definition 4, Feedback Relation, $x_1 \Leftrightarrow x_2$: There is a feedback relation between x_1 and x_2 if and only if

$$Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1) > Var\,(x_{1(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2) \qquad (10)$$

and

$$Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_2) > Var\,(x_{2(T+1)}\,|\,\underset{\sim}{x}_1, \underset{\sim}{x}_2). \qquad (11)$$

To study the dynamic relations of a bivariate system (e.g., dividends and earnings), we form the five statistical hypotheses in Table I, where the necessary and sufficient conditions corresponding to each hypothesis are given in terms of constraints on the parameter values of the VAR model.

Table I
Hypotheses on the Dynamic Relations of a Bivariate System

Hypotheses	The VAR Test
H_1: $x_1 \wedge x_2$	$\phi_{12}(L) = \phi_{21}(L) = 0$, *and* $\sigma_{12}=\sigma_{21}=0$
H_2: $x_1 \leftrightarrow x_2$	$\phi_{12}(L) = \phi_{21}(L) = 0$
H_3: $x_1 \not\Rightarrow x_2$	$\phi_{21}(L) = 0$
H_3^*: $x_1 \not\Rightarrow x_1$	$\phi_{12}(L) = 0$
H_4: $x_1 \Leftrightarrow x_2$	$\phi_{12}(L) \cdot \phi_{21}(L) \neq 0$

The above relational definitions may be generalized to investigate the relationship between the two variables x_1 and x_2 conditional on the information of x_3. For instance, the conditional feedback relation between x_1 and x_2 given the information of x_3 is equivalent to

$$Var\,(x_{1(T+1)} \,|\, \underset{\sim}{x}_1, \underset{\sim}{x}_3) > Var\,(x_{1(T+1)} \,|\, \underset{\sim}{x}_1, \underset{\sim}{x}_2, \underset{\sim}{x}_3) \tag{12}$$

and

$$Var\,(x_{2(T+1)} \,|\, \underset{\sim}{x}_2, \underset{\sim}{x}_3) > Var\,(x_{2(T+1)} \,|\, \underset{\sim}{x}_1, \underset{\sim}{x}_2, \underset{\sim}{x}_3) \tag{13}$$

The relations of definitions 1 to 3 can be similarly defined conditional on the information of x_3.

To determine a specific causal relation, we adopt a systematic multiple hypotheses testing procedure. This testing procedure avoids the potential bias induced by restricting the causal relation to a single alternative hypothesis. In implementing this test, we need to employ results of several pairwise hypotheses testing. For instance, in order to conclude that $x_1 \Leftarrow x_2$, we need to establish that $x_2 \not\Leftarrow x_1$ and to reject that $x_1 \not\Leftarrow x_2$. To draw a conclusion that $x_1 \leftrightarrow x_2$, we need to establish that $x_1 \not\Leftarrow x_2$ as well as $x_2 \not\Leftarrow x_1$ and also to reject $x_1 \wedge x_2$. In other words, it is necessary to examine all five hypotheses in a systematic way before a conclusion of a dynamic relationship can be drawn. In the following, we present an inference procedure that starts from examining a pair of the most general alternative hypotheses and then studies the pair of hypotheses with an increasing order of restrictiveness.

Our inference procedure for detecting dynamic relations is based on the principle that a maintained hypothesis should not be rejected unless there is sufficient evidence against it. In the causality literature (for example, Fiege and Pearce, 1979; Haugh, 1976; Hsiao, 1979; Pierce and Haugh, 1977; and Sims, 1972),. most tests intend to discriminate between independency and an alternative hypothesis. The primary purpose of the literature cited above is to reject the independency hypothesis. In contrast, we intend to identify the nature of the relationship between two economic series. The procedure consists of four testing sequences which implement a total of six tests (denoted as (a) to (f)), where each test examines a pair of hypotheses.

The four testing sequences and six tests are described as follows:

Step 1: examining the unidirectional relation vs. the feedback relation, i.e., implementing test (a), H_3 vs. H_4, and test (b), H_3^* vs. H_4;

Step 2: examining the contemporaneous relation vs. the unidirectional relation, i.e., implementing test (c), H_2 vs. H_3, and test (d), H_2 vs. H_3^*;

Step 3: examining the contemporaneous relation vs. the feedback relation, i.e., implementing test (e), H_2 vs. H_4;

Step 4: examining the independency vs. the contemporaneous relation, i.e., implementing test (f), H_1 vs. H_2.

Twelve possible outcomes, $E_1, \cdots, E_{12}$, arise from this inference procedure:

$E_1=\{(a)\ reject\ H_3,\ (b)\ reject\ H_3^*\}$
$E_2=\{(a)\ reject\ H_3,\ (b)\ not\ reject\ H_3^*\}$
$E_3=\{(a)\ reject\ H_3,\ (b)\ reject\ H_3^*\}$
$E_4=\{(a)\ not\ reject\ H_3,\ (b)\ not\ reject\ H_3^*\}$
$E_5=\{(c)\ reject\ H_2,\ (d)\ not\ reject\ H_2\}$
$E_6=\{(c)\ not\ reject\ H_2,\ (d)\ reject\ H_2\}$
$E_7=\{(c)\ reject\ H_2,\ (d)\ reject\ H_2\}$
$E_8=\{(c)\ not\ reject\ H_2,\ (d)\ not\ reject\ H_2\}$
$E_9=\{(e)\ reject\ H_2\}$
$E_{10}=\{(e)\ not\ reject\ H_2\}$
$E_{11}=\{(f)\ reject\ H_1\}$
$E_{12}=\{(f)\ not\ reject\ H_1\}$

where $\{(\gamma)$ reject $H_i\}$ indicates that H_i is rejected in the test (γ), $i = 1, 2, 3, 3^*, 4$ and $\gamma = a, b, \cdots, f$.

The inference procedure starts from carrying out tests (a) and (b) which result in one of the four possible outcomes, $E_1, \cdots$, or E_4. The three outcomes, E_1, E_2, and E_3, that lead to the conclusions of $x_1 \Leftrightarrow x_2$, $x_1 \Rightarrow x_2$, and $x_1 \Leftarrow x_2$ respectively, will stop the procedure at the end of the first step. However, when outcome E_4 is realized, tests (c) and (d) will be implemented. There again one of the four possible outcomes, $E_5, \cdots$, or E_8, will be realized. The realization of outcomes E_5 and E_6, which respectively indicates $x_1 \Leftarrow x_2$, and $x_1 \Rightarrow x_2$, will stop the procedure at the end of Step 2. On the other hand, the realization of outcome E_7 would lead to test (e) in Step 3 which has the consequences of either outcome E_9 or outcome E_{10}. Outcome E_9 implies $x_1 \Leftrightarrow x_2$ and concludes the procedure. Either outcome E_8 from Step 2 or outcome E_{10} from Step 3 will lead to test (f) in Step 4. This last step may generate two possible results, E_{11} and E_{12}, which imply $x_1 \leftrightarrow x_2$ and $x_1 \wedge x_2$, respectively.

4. Data Description

The returns data were calculated from the equity price indices of the five major international markets published by Taiwan Stock Exchange, which include the Japanese Nikkei 225, Hong Kong Hansen, Taiwan TSE, U.K. FTSE, Dow Jones industrial indices. The sample period of this study is January 1982, when a major deregulation of foreign exchange law was announced in Japan, through December 1992, a total of eleven years, with 2,279 daily observations.

There is a common belief in the financial literature that the integration of international markets became more significant after the crash in October 1987. Market segmentation is mainly resulted from the government regulation, which is documented by Errunza and Losq [1985] and Gultekin, Gultekin and Penati [1989]. Campbell and Hamao [1992] argue that the Japanese government deregulates several investment barriers before the crash of October 1987, such as the revision of the Foreign Exchange Law in December 1980, the "Yen-Dollar Agreement" in May 1984, and the liberalization of bond market in 1987.

We argue that international markets has become more integrated since the October 19 crash in 1987. Thus, three sample periods were defined: January 1, 1982- October 18, 1987 (pre-crash period), October 20, 1987- December 31, 1992 (post-crash period) and the whole sample period of January 1, 1982- December 31, 1992. An examination of sub-periods before and after the market crash provides more information on the extent of market integration.

Before presenting empirical results, a data description is provided. The mean and the standard derivation for each individual market and the correlations matrix for the five markets in the three different sample periods were shown in Table 1 and Table 2. Mean returns and standard derivations give us a picture of the risk-return relationship in an individual market. In the pre-crash period, Taiwan market enjoyed a highest average return in compensation with a modest volatility. However, in the post-crash period, Taiwan market suffered a low return with a highest volatility. The correlations of returns among markets show an increasing correlation between the international capital market in the post-crash period.

5. Empirical Results

The cross correlations in Table 3 showed a lag effect of one or two days between Taiwan and international markets in the pre-crash period. In the post-crash period, we hardly found significant lead-lag between markets except for the relation of Taiwan and the U.S. markets. It implies that information transmission between markets is speedy.

The VAR multiple hypotheses testing results in the pre-crash period were exhibited in Table 5 and Table 6, respectively. We used both Chi-square and AIC which were provided in SCA to determine the length of the lag at a 1% significant level. The unconditional causality test results show that, in the pre-crash period, the U.S. market returns have a unidirectional relation with Taiwan market. It supports the finding by Eun and Shim [1989], Hamao, Masulis and Ng [1990], that the U.S. market is the leading market in the world. In the pre-crash period, Taiwan market was independent to the U.K., the Japanese and the H.K. market. The empirical findings support the market segmentation between Taiwan and international capital markets in the pre-crash period.

After the October crash in 1987, the sample correlations between the six international markets have increased significantly. This is consistent with the common belief of a more integrated international capital market after the Crash. The conditional causality testing results gave us the same feedback relation between Taiwan and international capital markets in the pre-crash and the post-crash periods. The whole picture of the unconditional causality relation between Taiwan and international markets changed in the post-crash period. The U.S.

market remained a unidirectional relation with Taiwan market. However, the unconditional results showed a contemporaneous relation between Taiwan and international capital markets in the post-crash period. The changing from independency to contemporaneous relation supports the common belief that the international capital markets were getting integrated after the crash of October 1987.

In the whole period, the U.S. market had a unidirectional returns relation with the Taiwan market. The U.S. market transmitted its innovations to the Taiwan market unidirectionally. It supports the previous finding that the U.S. market is the leading market in the world. Taiwan market is not an exception.

Under the condition of isolating the U.S. effect, we find a feedback relation between Taiwan and international capital markets, including the U.K., the H.K., and the Japanese markets. It implies an integration of international capital markets. In examining the structure change between the pre-crash and post-crash periods, we documented a change from independency to contemporaneous relation between Taiwan and international market. In the pre-crash period, the unconditional causality tended to support the market segmentation argument. However, the contemporaneous relation in the post-crash period apparently favor the argument of international market integration.

6. Conclusion

In this study we confirm the findings of previous studies that the U.S. market is the leading market in the world. Taiwan is not an exception. Information transmission between international capital markets is fairly speedy. The conditional causality testing results show a feedback relation between Taiwan and international capital markets. It shows an integration of international capital markets.

In examining the structure changes between Taiwan and international capital markets, we found that the return relations change from independency to contemporaneous relation in the post-crash period. It implied that Taiwan market were getting integrated with international markets after the October crash 1987. The empirical finding of the unidirectional leading relations from the U.S. market to Taiwan market made possible to develop an international contrarian strategy proposed by Lo and Mackinlay [1990].

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Table 1.
Summary of means and standard derivations of market returns

Pre-crash period	Mean	Standard Deviation
U.S. Dow Jones	0.0005	0.0134
Japanese Nikkei	0.0009	0.0089
U.K. FTSE	0.0008	0.0112
H.K. Hansen	0.0006	0.0201
Taiwan TSE	0.0014	0.0142
Post-crash period	Mean	Standard Deviation
U.S. Dow Jones	0.0005	0.0107
Japanese Nikkei	-0.0002	0.0156
U.K. FTSE	0.0004	0.0123
H.K. Hansen	0.0007	0.0175
Taiwan TSE	0.0001	0.0325
The whole period	Mean	Standard Deviation
U.S. Dow Jones	0.0005	0.0122
Japanese Nikkei	0.0003	0.0125
U.K. FTSE	0.0006	0.0117
H.K. Hansen	0.0006	0.0190
Taiwan TSE	0.0008	0.0244

Table 2.
Summary of correlations between market returns

Pre-crash period	Dow	Nikkei	FTSE	HK	TSE
Dow	1.00	0.10	0.15	0.05	-0.02
Nikkei	0.10	1.00	0.10	0.11	0.02
FTSE	0.15	0.10	1.00	0.07	0.00
HK	0.05	0.11	0.07	1.00	0.00
TSE	-0.02	0.02	0.00	0.00	1.00
Post-crash period	Dow	Nikkei	FTSE	HK	TSE
Dow	1.00	0.15	0.32	0.21	0.04
Nikkei	0.15	1.00	0.32	0.31	0.12
FTSE	0.32	0.32	1.00	0.25	0.09
HK	0.21	0.31	0.25	1.00	0.09
TSE	0.04	0.12	0.09	0.09	1.00
The whole period	Dow	Nikkei	FTSE	HK	TSE
Dow	1.00	0.13	0.28	0.16	0.01
Nikkei	0.13	1.00	0.22	0.21	0.10
FTSE	0.28	0.22	1.00	0.17	0.06
HK	0.16	0.21	0.17	1.00	0.05
TSE	0.01	0.10	0.06	0.05	1.00

Table 3.
The χ^2 test results of unconditional lag correlations between market returns

Pre-crash period	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Dow-TSE	52.49**	24.65**	9.12	8.43	12.61*	7.20
Nikkei-TSE	50.41**	5.56	6.16	10.53*	3.02	1.23
FTSE-TSE	42.14**	11.39*	12.09*	14.54*	1.97	1.78
Hansen-TSE	47.20**	20.24**	13.15*	6.27	15.85**	3.55
Post-crash period						
Dow-TSE	31.28**	11.14**	6.65	0.90	11.90*	11.57*
Nikkei-TSE	8.34	15.94**	3.49	4.35	13.38*	9.11
FTSE-TSE	5.16	3.40	4.58	2.99	8.07	3.08
Hansen-TSE	4.59	3.17	8.27	7.34	7.58	10.40*
The whole period						
Dow-TSE	30.39**	11.37*	9.46*	1.60	12.98*	7.27
Nikkei-TSE	22.98**	25.63**	4.62	4.59	19.62**	7.53
FTSE-TSE	14.89**	7.24	3.26	2.46	11.64*	3.52
Hansen-TSE	13.54**	16.58**	9.00	6.16	10.32*	4.53

* 5% significant level
** 1% significant level

Table 4.

The χ^2 test results of conditional lag correlations between market returns

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Pre-crash period						
Nikkei-TSE(D)	156.13**	19.27*	11.05	15.14	4.66	3.68
FTSE-TSE(D)	80.81**	27.16**	19.23*	21.58*	3.21	4.19
Hansen-TSE(D)	82.38**	27.25**	16.51	12.59	15.56	7.32
Hansen-TSE(N)	65.29**	23.23**	14.68	14.58	16.47	7.01
Post-crash period						
Nikkei-TSE(D)	62.15**	32.11**	8.05	8.14	20.46*	21.48*
FTSE-TSE(D)	65.04**	13.82	8.17	4.84	20.82*	15.70
Hansen-TSE(D)	80.32**	21.21*	13.74	7.15	16.42	22.91**
Hansen-TSE(N)	11.04	18.08*	17.89*	16.96*	16.60	20.07*
The whole period						
Nikkei-TSE(D)	163.90**	45.31**	9.66	9.20	28.01**	17.30*
FTSE-TSE(D)	91.07**	16.99*	10.12	8.50	28.59**	11.70
Hansen-TSE(D)	100.32**	34.10**	22.79**	10.52	24.03**	12.98
Hansen-TSE(N)	30.20**	39.48**	16.06	14.59	23.93**	14.87

* 5% significant level

** 1% significant level

Table 5.
The unconditional causality relations between markets

	Backwards			Forwards		
	1%	5%	10%	1%	5%	10%
Pre-crash period						
DT	30	30	30	30	30	1
NT	4	1	1	1	1	1
FT	1	1	1	1	1	1
HT	1	1	1	1	1	1
Post-crash period						
DT	30	30	30	30	30	30
NT	2	2	2	2	2	2
FT	2	2	2	2	2	2
HT	2	2	2	2	2	2
The whole period						
DT	30	30	30	1	1	1
NT	3	2	2	3	2	2
FT	2	2	2	2	2	2
HT	2	2	1	2	2	1

1, 2, 3, 4, and 5 represent independent, contemporaneous, unidirectional, backward unidirectional and feedback relation between two markets, respectively. 30 represents a strong unidirectional relation.

D, N, F, H, and T represent Dow, Nikkei, FTSE, Hansen and TSE index, respectively.

Table 6.

The conditional causality relations between markets

	Backwards 1%	Backwards 5%	Backwards 10%	Forwards 1%	Forwards 5%	Forwards 10%
Pre-crash period						
N-T(D)	5	5	50	5	5	50
F-T(D)	5	5	5	5	5	5
H-T(D)	5	5	50	5	5	50
H-T(D)	5	5	5	5	5	5
Post-crash period						
N-T(D)	5	5	5	5	5	5
F-T(D)	5	5	5	5	5	5
H-T(D)	5	5	5	5	5	5
H-T(N)	5	5	5	5	5	5
The whole period						
N-T(D)	5	5	5	5	5	5
F-T(D)	5	5	5	5	5	5
H-T(D)	5	5	5	5	5	5
H-T(N)	5	5	5	5	5	5

1, 2, 3, 4, and 5 represent independent, contemporaneous, unidirectional, backward unidirectional and feedback relation between two markets, respectively. 50 represents a strong feedback relation.

D, N, F, H, and T represent Dow, Nikkei, FTSE, Hansen and TSE index, respectively.

台灣國際資本場間之條件與無條件因果關係

蘇永成*

摘要

本研究探視 1982-1992 年間台灣與國際資本市場，包括美國.英國，日本，及香港市場間之條件與無條件因果關係，我們將整個研究期間分成兩個樣本，即崩盤前之 1982 年 1 月到 1987 年 10 月 18 日以及崩盤後之 1987 年 10 月 20 日到 1992 年 12 月。本研究採用多重假說檢定方式以了解成對因果關係，此檢定方式可以有系統地檢視有關台灣與國際資本市場間之各種相關假說，我們發現在獨立美國效果後，台灣與國際資本市場間呈現回饋關係，這顯示台灣和國際資本市場間之整合。在檢視市場間之無條件因果時，我們發現在崩盤前獨立關係及崩盤後同期關係，這更加顯示台灣和國際資本市場在 1987 年十月大崩盤後之整合。

關鍵詞：條件因果，無條件因果，國際資本市場

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