Stock Market Interdependence and Trade Relations: A Correlation Test for the U.S. and Its Trading Partners

Steven Zongshin Liu
Professor, Department of Economics, Feng Chia University, Taiwan.

Kung-Cheng Lin
Associated Professor, Department of Public Finance, Feng Chia University, Taiwan.

Sophia Meiying Lai
Ph.D. Candidate, Department of Economics, Feng Chia University, Taiwan

Abstract

Based on the well-established trade relations between the U.S. and its major trading partners, this paper examines the robustness of the trade relation hypothesis which, in some recent studies, argues that difference in trade relations among countries can significantly explain difference in the stock market interdependence. The generalized VDC analysis is employed to measure the stock market interdependence, and the correlation test with bootstrap procedure is applied to test the hypothesis. The results indicate that the hypothesis is hardly as a general rule.

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1. Introduction

The interdependence among national stock markets has been investigated by numerous studies. In general, except in some emerging markets, such as those in Taiwan and South Korea, with severe restrictions on foreign investment, a substantial amount of interdependence has been evidenced, especially in the post-October 1987 crash of the New York stock exchange. Moreover, markets with close geographic and economic proximity exert more significant influences over each other.

The recent research arena is attempting to explore what economic fundamentals determine the stock market interdependence? However, studies on the issue so far have been few in number, and the results are either contradictory or unsatisfactory. Von Furstenberg and Jeon (1989) find that only few demand-side economic events have significant effects on the stock price changes of four major markets (the U.S., Japan, Germany, and the UK), and claim that national stock market interdependence may simply reflect contagious market shocks, unrelated to economic fundamentals. Similar results have been reported by, for example, Karolyi and Stulz (1996) for the U.S. and Japan markets, and Serra (2000) for 26 emerging markets. In contrast, Pretorius (2002) shows that, among possible fundamentals, bilateral trade and industrial production growth differentials are significant in influencing the correlations between 10 emerging markets. Bracker et al. (1999) investigate the stock market co-movements between 9 well-established stock markets, and find that bilateral import dependence, geographic distance, market size differentials, and real interest differentials are the significant factors. Moreover, focusing on trade relations, Chen and Zhang (1997) demonstrate that the cross-country return correlations of Pacific-Basin markets are significantly related to trade activities. Soydemir (2000) argues that difference in the stock market response patterns of three emerging countries (Mexico, Argentina, and Brazil) is consistent with difference in their trade flows with the U.S.

From previous studies, trade relation is seemed relatively the most significant economic determinant of stock market interdependence, and difference in the stock market interdependence could be significantly explained by difference in trade relations among countries. The underlying economic foundation is that trading activities link the cash flows of trading partners, thereby making their stock markets more highly correlated (Chen and Zhang 1997, Bracker et al. 1999, Pretorius 2002). If two countries have tighter trade relations, their stock markets should be more interdependent, and stock price response patterns should be more predictable (Soydemir 2000). The aim of this study, however, is intending to examine the robustness of such previous findings, which, for simplicity, is referred to here as the *trade relation hypothesis*, that difference in trade relations among countries can significantly explain difference in the stock market interdependence.

The first motivation of this study is to change the coverage of the stock markets explored. Among previous studies that support the explanatory power of trade relations, Chen and Zhang (1997) explore Asia Pacific markets, while Soydemir (2000) and Pretorius (2002) more specifically investigate several emerging markets. Unlike any of those, this study delves into the stock markets of the U.S. and its 10 major trading partners, which mostly consist of developed countries and the Asian Newly Industrialized Economies (ANIEs). Trade relations among these countries are all well established, rather than weak, and differ in degree. This enables us to examine the robustness of the trade relation hypothesis, i.e., whether it holds as a general rule or just in special cases, such as in emerging markets.

The second motivation is to measure the stock market interdependence more realistically and to conduct a simple and reliable test for the hypothesis. As many previous studies (e.g., Eun and Shim 1989, Chowdhury 1994, Dekker et al. 2001, Elyasiani et al. 1998, Janakiramanan and Lamba 1998, Rogers 1994, Sheng and Tu 2000, Soydemir 2000), this study uses variance decompositions (VDCs) of forecast errors of returns to measure the stock market interdependence. The VDCs are calculated through simulations on an estimated vector autoregressive (VAR) model. However, rather than the traditional approach of VDC analysis (Sims, 1980) where the VDCs are not invariant to the ordering of the variables in the VAR model, this study employs the newly-developed generalized approach by Pesaran and Shin (1998). The greatest advantage of the generalized approach is that the VDCs are invariant to the ordering of the variables in the model and can yield more realistic measures of the stock market interdependence, particularly for those markets with close geographical links can exhibit influences over each other (Dekker et al. 2001).

This paper conducts, for the first time, the correlation test with bootstrap procedure to test the hypothesis. The correlation coefficients (ρs) between VDCs and trade relations are calculated and tested. Since the observations of VDCs and trade relations are small and the distribution of ρ is unknown, the bootstrap procedure then is conducted to obtain appropriate confidence intervals. This allows for greater accuracy and reliability in testing the significance of ρ. Intuitively, a large and significant correlation coefficient implies that the trade relation hypothesis is true.

The remainder of this paper is organized as follows. Section 2 describes the data used. Section 3 briefly introduces the methodology. Section 4 analyzes the empirical results. The last section presents the conclusions.

2. Data

This study uses the U.S. and its 10 major trading partners as sample countries in order to capture the notions that: (1) trade relations are all well established and differ in degree, and (2) countries can be grouped into different regions to reflect geographic links. Ranked in descending order of their 1992-2001 total trade values with the U.S., the 10 trading partners are Canada, Japan, Mexico, Germany, the UK, Taiwan, South Korea, France, Singapore, and Hong Kong. All countries explored are located in three different continental regions (the U.S., Canada, and Mexico in America; the UK, Germany, and France in Europe; Japan, Taiwan, South Korea, Singapore, and Hong Kong in Asia), and their stock markets are among the most important in each region.

Trade relations among countries are measured by average shares (percentages) of values of exports, imports, and total trade, respectively, of foreign countries out of the home country. Table I shows the trade relations. All trade data are collected from *Direction of Trade Statistics*, Yearbook (1992-2001), International Monetary Fund (IMF). As shown, in aggregate, these 10 trading partners comprise about 65 percent of total U.S. trade, but individually their shares are quite different (US Panel). For all other countries, except Germany and France, the U.S. is the biggest trading partner. Canada and Mexico, in particular, have extremely high trade dependencies upon the U.S. Moreover, these countries are major trading partners with each other, but individual trade relations are very different. The aggregate foreign trade shares of each of the American and Asian countries are almost all greater than 50 percent.

[INSERT TABLE I ABOUT HERE]

Daily closing stock indices from January 1992 to December 2001 in local currencies are used. This is because monthly or even weekly data may be too long and obscure the potential interactions that last only a few days (Eun and Shim 1989, Chowdhury 1994). The period starts from 1992 because Taiwan and South Korea opened up foreign investment in their domestic markets in January 1991 and 1992, respectively, earlier data may have restricted the degree of interdependence of these two markets with others. Table II gives the stock indices used of all markets. The stock indices are collected from *Datastream*, and only weekday (Monday to Friday) data are collected. All daily indices are transformed to daily rates of return in the empirical estimations, calculated as the log-difference as follows: $R_{jt} = \ln Y_{jt} - \ln Y_{jt-1}$, where R_{jt} denotes the rate of return of the *j*th market on day *t*, and Y_{jt} (Y_{jt-1}) denotes the stock index on day *t* (*t*-1).

[INSERT TABLE II ABOUT HERE]

3. Methodology

3.1 Stationarity and Cointegration Tests

Since the VAR model is estimated with difference stationary data (the rates of return), two tests are conducted before the estimation because differencing to achieve stationarity could introduce distortions into multivariate models. The first is the stationarity test for each stock index in level and in first difference. The second is the cointegration test of all stock indices as a whole if they are found to be nonstationary.

For the stationarity tests, the ADF test is first conducted to test the null (H_0) of time series is integrated of order one, I(1). Since the ADF test tends to have low power to reject H_0 when the time series is near I(1), the KPSS (Kwiatkowski et al. 1992) test is also conducted to test the null of stationary time series, I(0). The Johansen multivariate cointegration test (Johansen 1988, 1991; Johansen and Juselius 1990) is applied in this study. If the cointegration relationship is not present, using differenced data is suitable.

3.2 Generalized VDC Analysis

Consider the *m*-dimensions VAR model as follows:

$$R_t = C + \sum_{s=1}^{p} \phi_s R_{t-s} + \varepsilon_t \qquad (1)$$

where R_t is the *m*×1 (*m*=11) column vector of the jointly determined rates of return of the eleven stock markets, and all series of returns are assumed to be stationary; C is an *m*×1 column vector of constants; ϕ_s, $s = 1, 2, \cdots, p$, are $m \times m$ coefficient matrices and *p* is the lag length; and ε_t is the *m*×1 column vector of forecast errors of the linear predictor of R_t using all the past R_{t-s}. By construction, ε_t is serially uncorrelated, however, the components of ε_t may be contemporaneously correlated. That is, $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon'_{t-s}) = 0$ for all $s \neq 0$, and $E(\varepsilon_t \varepsilon_t') = \Omega$ for all *t*, where $\Omega = \{\sigma_{ij}, i, j = 1, 2, \cdots, m\}$ is an $m \times m$ positive definite matrix. To analyze the system's reaction to random shocks, Eq. (1) can be rewritten as a moving average representation as:

$$R_t = \mu + \sum_{s=0}^{\infty} A_s \varepsilon_{t-s} \quad (2)$$

where μ is column vector of constants. The *i,j*th component of A_s, therefore, shows the response of the *i*th market in *s* periods after a unit random shock in the *j*th market.

An impulse response function measures the time profile of the effect of shocks at *t* on the (expected) future values ($t+n$, $n = 0,1,2,\cdots$) of the variables in a dynamic system. Since the components of ε_t may be contemporaneously correlated, it is necessary to transform ε_t for the purpose of observing distinct response patterns. The traditional approach (Sim 1980) uses the Cholesky decomposition of Ω. Let V be an $m \times m$ lower triangle matrix, $VV' = \Omega$, then Eq. (2) can be rewritten as:

$$R_t = \mu + \sum_{s=0}^{\infty} B_s \xi_{t-s}$$

where $B_s = A_s V$, $\xi_{t-s} = V^{-1}\varepsilon_{t-s}$ (the orthogonalized innovation), and $E(\xi_t \xi_t') = I_m$. Hence, the $m \times 1$ column vector of the orthogonalized IRF of a unit shock in the *j*th equation on future R_{t+n} is given by: $\psi_j^0(n) = B_n e_j$, $n = 0,1,2,\cdots$, where e_j is an $m \times 1$ vector with unity as its *j*th element and zero elsewhere.

The shortcoming of the traditional approach is that the IRFs are not invariant to the ordering of the variables in the VAR model, but this is overcome by employing the generalized approach (Pesaran and Shin 1998). Suppose that δ_j is a shock at time *t* to the *j*th element of ε_t, where ε_t has a multivariate normal distribution, then the $m \times 1$ vector of the unscaled generalized IRF on R_{t+n} is given by:[1]

$$\left(\frac{A_n \Omega e_j}{\sqrt{\sigma_{jj}}}\right)\left(\frac{\delta_j}{\sqrt{\sigma_{jj}}}\right), \quad n = 0,1,2,\cdots \quad (3)$$

By setting $\delta_j = \sqrt{\sigma_{jj}}$ in Eq. (3), i.e., one standard error shock, the scaled generalized IRF is obtained: $\psi^g(n) = \sigma_{jj}^{-\frac{1}{2}} A_n \Omega e_j$, $n = 0,1,2,\cdots$. The generalized IRF, therefore, can be used to derive the generalized VDC of forecast errors, defined as the proportion of the *n*-step ahead forecast error variance of the *i*th variable which is accounted for by the innovations of the *j*th variable in the VAR model. The generalized VDCs are calculated, for $n = 0,1,2,\cdots$, as follows:

$$\theta_{ij}^g(n) = \frac{\sigma_{ii}^{-1} \sum_{l=0}^{n} \left(e_i' A_l \Omega e_j\right)^2}{\sum_{l=0}^{n} e_i' A_l \Omega A_l' e_i}, \quad i,j = 1,2,\cdots,m \quad (4)$$

Note that owing to the non-zero covariance between the original shocks, in general, $\sum_{j=1}^{m} \theta_{ij}^g(n) \neq 1$. The VDCs of Eq. (4) provide measures of the relative importance of the markets in generating fluctuations of stock returns in their own and in other markets, and, hence, can be used as measures of the interdependence among stock markets.

[1] For detailed derivations of generalized IRF and VDC, see Pesaran and Shin (1998).

3.3 Correlation Tests

Once the VDCs of all stock markets are obtained, the correlation coefficients (ρs) between the VDCs of, for instance, the U.S. market and trade shares of the 10 trading partners out of the U.S. are calculated and tested. If the trade relation hypothesis is true, the calculated ρs should be large and significantly different from zero. Other countries' ρs are also calculated and tested in the same fashion.

Because only 10 observations on trade shares and VDCs are available in each country panel and the distribution of ρ is unknown, for testing the significance of each calculated ρ, the resampling nonparametric bootstrap procedure is performed to obtain the confidence interval.[2] To explain, for testing the significance of ρ between VDCs of the U.S. market and trade shares of its 10 trading partners out of the U.S., let $B = [(x_1, y_1), (x_2, y_2), \cdots, (x_{10}, y_{10})]$ be the country pairs of VDCs and trade shares. First, calculate $\hat{\rho}$ from the pairs. The bootstrap procedure involves drawing from B with replacements repeatedly n times (n=10,000 in this study). Call this bootstrap sample $B^{*(i)} = [(x_1^{*(i)}, y_1^{*(i)}), (x_2^{*(i)}, y_2^{*(i)}), \cdots, (x_{10}^{*(i)}, y_{10}^{*(i)})]$, $i = 1, 2, \cdots, n$. For each $B^{*(i)}$ calculate $\hat{\rho}^{*(i)}$. Then, estimate the standard error of $\hat{\rho}$ using the bootstrap sample standard error of $\hat{\rho}^{*(i)}$ and obtain its distribution, referred to as the bootstrap distribution of $\hat{\rho}$. Ordering all $\hat{\rho}^{*(i)}$, the two-side $(100 - 2\alpha)$ confidence interval for $\hat{\rho}$ is $(\hat{\rho}^{*(n\alpha)}, \hat{\rho}^{*(n(1-\alpha))})$, where $\alpha = 2.5\%$, 5%, and 10% percentile of all $\hat{\rho}^{*(i)}$, respectively. Accordingly, the significance of $\hat{\rho}$, $H_0 : \rho = 0$ against $H_1 : \rho \neq 0$, at the 5%, 10%, and 20% levels, respectively, can be tested.[3] If the confidence interval contains zero, $\hat{\rho}$ is considered insignificantly different from zero.

4. Empirical Results

The results of the stationarity tests indicate that all stock indices are non-stationary, I(1), in the logarithmic levels but are stationary, I(0), in first differences. Since all stock indices are I(1) in level, the Johansen cointegration test is conducted. The test results reveal that no cointegrating vector exists among the eleven stock indices. Thus, an eleven-market VAR model is estimated with the stationary log-differences of the stock indices, i.e., the rates of return.[4]

In estimating the VAR model, the selected lag length p is one period (day) based on the Akaike information criterion (AIC). However, a longer 5 lags (equivalent to a week) is used, because serial correlations in the residuals of individual regressions with only 1 lag can effectively be reduced and the delayed responses of one market to

[2] For a more detailed description of the bootstrap methods and their applications, see, for example, Maddala and Kim (1998, Chapter 10) and Casella and Berger (2002, Chapter 10).

[3] The levels of significance are set up to 20% because most of the obtained bootstrap distributions with larger positive $\hat{\rho}$ asymmetrically have a long left tail (negative skewness), i.e., including extreme scatters of negative $\hat{\rho}^{*(i)}$ on the left-hand side, and makes it easier to include zero in the confidence intervals in a small α, thereby leading to the failure to reject the null and make a type II error.

[4] Due to space constrains, the results of unit root and cointegration tests are not reported here. However, they are available from the author upon request.

innovations in other markets are more evident.[5]

4.1 Stock Market Interdependence

Table III provides the VDCs of 5-day, 10-day, and 15-day ahead forecasts of stock returns in fractions that are attributed to innovations of different markets. From Table III, several major findings emerge. First, a substantial number of interactions exist among stock markets. Measuring with the VDCs at 15-days ahead, the proportion of variance in the U.S. market attributed to the combined innovations in its trading partners' markets is about 50 % (last column, US Panel). As for the other countries, the proportions of variances attributable to the combined innovations in foreign markets (last column of Table III) range from the lowest of 20% for Taiwan to the highest of 62.5% for Germany. It is apparent that the Taiwan and South Korea markets are mostly isolated from other markets although they were opened to foreigners in 1991 and 1992, respectively.

Second, by region, the European stock markets (UK, GM, and FRN) are most interactive with foreign markets, followed by the three American markets. The Asian markets, except for those of Hong Kong and Singapore, turn out to be more isolated from foreign markets. In each of the three European markets, more than 60% of the variance is attributed to foreign innovations, a higher proportion than that of the U.S. market.

Third, intra-regional interdependence is, in general, higher than inter-regional interdependence. This is particularly apparent among the markets in the American and European regions. The phenomenon of high intra-regional interdependence, as many previous studies interpreted, may reflect geographic proximity.

Fourth, the U.S. market is, on average, the most influential, followed closely by the markets of other developed countries except Japan. The U.S. market explains the variances of foreign markets from 2.5% for Taiwan to 17% for Canada, for an overall average of 8.05% (the average of the entries in the third column of Table III). The stock markets of other developed countries explain an average of 6.94% (GM, the seventh column of Table III) to 7.85% (CA, the fourth column of Table III) of the variance in foreign markets. The Japanese market, however, explains an average of only 1.23% (the ninth column of Table III) of foreign markets' variance. In contrast, the Taiwan and South Korea markets reveal less influence on foreign markets.

Finally, the interdependence of a given country's stock market with each of the foreign markets is quite different. The U.S. market, for instance, is mostly interdependent with the Canadian market (18%), but the interdependence with either the market of South Korea or Taiwan is extremely low (about 0.3%). This study attempts to test whether or not such difference in stock market interdependence can be significantly explained by difference in trade relations.

[INSERT TABLE III ABOUT HERE]

4.2 Testing Trade Relation Hypothesis

Table IV provides the correlation coefficients between VDCs of the stock markets and shares of exports, imports, and total trade, respectively, of all countries. As previously mentioned, a large and significant correlation coefficient implies that the trade relation

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[5] Similar to this study using daily stock indices to estimate the VAR, Eun and Shim (1989) and Janakiramanan and Lamba (1998) use 15 lags, Chowdhury (1994) uses 12 lags, and Dekker et al. (2001) use 9 lags. This study also tries 1 lag and 9 lags in addition to 5 lags; however, the main conclusions remain.

hypothesis is true.

[INSERT TABLE IV ABOUT HERE]

As shown, the correlation coefficients in different regions vary widely with regard to magnitude and/or significance. In the American countries, all ρs are large but only three are significantly different from zero. For the U.S., only ρ (0.8) of VDCs and exports is weakly significant (20% level), while the other two are insignificant. For Canada and Mexico, on account of their geographical proximity to and extreme trade-dependence upon the U.S., two sets of ρs are calculated: one that includes the U.S. and one that excludes it (entries in parentheses, panels for CA and MEX). In the case of Canada, when the U.S. is included, all ρs are large but insignificant; however, when the U.S. is excluded, all ρs are almost zero and insignificant. This implies that the interdependence of the Canadian stock market is in fact quite independent of trade relations with other countries, the overall ρs hence are insignificant. In contrast, the ρs of Mexico are more significant and, in particular, the ρ of VDCs and exports is highly significant, no matter if the U.S. is included or not. This indicates that difference in export relations with foreign countries can significantly explain difference in the interdependence of the Mexican market with foreign markets. What is learned here is that the question as to whether or not the trade relation hypothesis is held in the American countries must be dealt with caution. Without rigorous tests on the significance, incorrect interpretation may occur even though the ρs are large.

In comparison with Canada and Mexico, the European and Asian countries have more dispersed trade relations with foreign countries. Table IV shows that in the European countries all ρs are large and significantly different from zero, indicating that the trade relation hypothesis holds true. In the Asian countries, however, all ρs are almost zero and insignificant, and some are even negative. Certainly, the hypothesis cannot be true. The findings of this study regarding the Asian countries are inconsistent with those reported by Chen and Zhang (1997).

5. Conclusions

To know the economic determinants of the stock market interdependence has important implications for equity diversification of international investors. Applying the correlation test with bootstrap procedure, this study examines the *trade relation hypothesis* which, in some recent studies, argues that difference in trade relations among countries can significantly explain difference in the stock market interdependence.

The test results reveal that the hypothesis is hardly as a general rule. It is held only in some countries or in some specific trade relations. The most interesting finding is that the hypothesis is significantly held in the European countries, but fails to be true in the Asian countries. In the American countries, however, the hypothesis must be dealt with caution. It is held only weakly in the export relations of the U.S. with its trading partners, but is strongly held in the export relations of Mexico with foreign countries. For Canada, the hypothesis fails to be true.

The findings of this study shed clearer and more specific light on the robustness of the trade relation hypothesis. They provide useful information for international investors, as well as further studies.

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Table I Trade Relations among Countries and Their Trading Partners (Average %)

Country	Export to/Import from/Total Trade with											Subtotal of Foreign Trade Shares
	US	CA	MEX	UK	GM	FRN	JAP	TW	HK	SIN	SK	
US												
Exports	–	22.00	10.75	5.35	3.95	2.67	9.60	3.05	2.08	2.45	3.45	65.35
Imports	–	18.92	9.03	3.69	5.04	2.52	14.80	3.74	1.29	2.04	2.98	64.05
Trade	–	20.19	9.74	4.38	4.58	2.58	12.60	3.44	1.62	2.20	3.18	64.51
CA												
Exports	83.69	–	0.45	1.42	0.98	0.59	3.36	0.46	0.43	0.15	0.78	92.31
Imports	71.86	–	2.76	2.90	2.33	1.65	5.63	1.32	0.56	0.49	1.36	90.86
Trade	78.10	–	1.54	2.11	1.62	1.09	4.44	0.87	0.49	0.31	1.05	91.62
MEX												
Exports	85.64	2.12	–	0.53	0.89	0.53	1.06	0.08	0.23	0.24	0.11	91.43
Imports	80.14	2.18	–	0.90	4.08	1.44	4.83	1.01	0.32	0.41	1.68	96.99
Trade	82.76	2.15	–	0.73	2.56	1.01	3.02	0.56	0.28	0.32	0.92	94.31
UK												
Exports	13.43	1.46	0.29	–	11.94	9.46	2.20	0.56	1.63	1.11	0.67	42.75
Imports	12.75	1.48	0.20	–	13.25	8.80	5.29	1.21	2.33	1.23	1.11	47.65
Trade	13.06	1.47	0.24	–	12.63	9.11	3.84	0.91	2.01	1.17	0.91	45.35
GM												
Exports	8.66	0.67	0.69	8.17	–	11.52	2.34	0.88	0.74	0.65	0.89	35.21
Imports	7.70	0.69	0.20	6.66	–	10.67	5.24	1.21	0.55	0.69	0.98	34.59
Trade	8.21	0.68	0.46	7.47	–	11.12	3.70	1.03	0.65	0.67	0.93	34.92
FRN												
Exports	7.08	0.80	0.41	9.59	16.10	–	1.71	0.60	0.95	0.67	0.65	38.56
Imports	8.07	0.61	0.20	7.99	17.62	–	3.16	0.72	0.24	0.66	0.59	39.86
Trade	7.57	0.71	0.31	8.80	16.86	–	2.42	0.66	0.60	0.67	0.62	39.22

Table I Trade Relations among Countries and Their Trading Partners (Average %) (Cont.)

Country	Export to/Import from/Total Trade with											Subtotal of Foreign Trade Shares
	US	CA	MEX	UK	GM	FRN	JAP	TW	HK	SIN	SK	
JAP												
Exports	29.37	1.58	1.01	3.30	4.62	1.51	–	6.73	6.22	4.57	6.11	65.02
Imports	21.09	2.87	0.51	2.02	3.90	1.95	–	4.26	0.71	1.80	5.13	44.24
Trade	26.17	2.13	0.80	2.75	4.32	1.70	–	5.67	3.87	3.39	5.69	56.49
TW												
Exports	25.18	1.46	0.61	2.67	3.56	1.18	10.54	–	22.03	3.51	2.01	72.75
Imports	19.62	1.28	0.28	1.62	4.93	2.52	27.59	–	1.87	2.82	4.73	67.26
Trade	22.52	1.37	0.45	2.17	4.21	1.82	18.68	–	12.41	3.18	3.31	70.12
HK												
Exports	22.72	1.57	0.39	3.59	4.27	1.63	5.69	2.47	–	2.54	1.59	46.46
Imports	7.34	0.57	0.10	2.03	2.20	1.39	13.93	8.62	–	4.67	4.69	45.54
Trade	14.79	1.05	0.24	2.79	3.20	1.51	9.93	5.64	–	3.64	3.19	45.98
SIN												
Exports	18.71	0.47	0.37	2.94	3.36	1.67	7.43	4.23	8.43	–	2.98	50.59
Imports	16.36	0.42	0.25	2.57	3.34	2.32	18.63	3.99	3.20	–	3.48	54.56
Trade	17.50	0.44	0.31	2.75	3.34	2.00	13.15	4.11	5.77	–	3.24	52.61
SK												
Exports	19.98	1.37	1.17	2.58	3.61	1.10	12.25	3.54	7.50	3.92	–	57.02
Imports	20.62	1.76	0.22	1.79	4.07	1.52	21.27	1.99	0.76	1.87	–	55.87
Trade	20.30	1.56	0.71	2.20	3.84	1.30	16.71	2.79	4.15	2.89	–	56.45

Note: Entries are shares (average percentages from 1992 to 2001) of exports to, imports from, and total trade (exports + imports) with countries in the top row out of the country on the left-hand side.

Source: Shares of exports, imports, and total trade are calculated from the values of exports, imports, and total trade (in terms of U.S. dollars) of each country on the left-hand side, *Direction of Trade Statistics*, *Yearbook*, IMF, 1992-2001.

Table II Stock Indices

Country	Symbol	Index
Taiwan	TW	Weighted Stock Price
Japan	JAP	Nikkei 225
South Korea	SK	Korea Composite
Hong Kong	HK	Hang Seng
Singapore	SIN	Straits Times
France	FRN	CAC 40
United Kingdom	UK	FTSE 100
Germany	GM	CDAX General
Mexico	MEX	Mexico Bolsa
Canada	CA	S&P/TSE Composite
United States	US	Dow Jones Industrial Average

Table III Generalized Variance Decompositions (VDCs)

Market Explained	Horizon (in days)	By Innovations in											Foreign Total
		US	CA	MEX	UK	GM	FRN	JAP	TW	HK	SIN	SK	
US	5	49.75	17.57	9.82	7.31	5.99	6.95	0.49	0.24	0.81	0.82	0.25	50.25
	10	49.72	17.56	9.82	7.32	6.00	6.96	0.49	0.25	0.81	0.82	0.26	50.29
	15	49.72	17.56	9.82	7.32	6.00	6.96	0.49	0.25	0.81	0.82	0.26	50.29
CA	5	16.90	46.94	8.42	7.41	8.60	7.85	0.75	0.17	1.30	1.25	0.40	53.05
	10	16.90	46.93	8.42	7.41	8.60	7.85	0.75	0.18	1.30	1.25	0.40	53.06
	15	16.90	46.93	8.42	7.41	8.60	7.85	0.75	0.18	1.30	1.25	0.40	53.06
MEX	5	11.99	10.38	60.72	4.97	4.27	4.51	0.29	0.16	1.36	0.87	0.48	39.28
	10	11.98	10.38	60.70	4.97	4.27	4.52	0.29	0.17	1.36	0.87	0.49	39.30
	15	11.98	10.38	60.70	4.97	4.27	4.52	0.29	0.17	1.36	0.87	0.49	39.30
UK	5	8.51	7.45	4.26	39.42	14.45	19.13	1.59	0.12	2.56	1.83	0.69	60.59
	10	8.51	7.45	4.26	39.40	14.45	19.12	1.59	0.13	2.56	1.84	0.69	60.60
	15	8.51	7.45	4.26	39.40	14.45	19.12	1.59	0.13	2.56	1.84	0.69	60.60
GM	5	9.39	9.03	4.46	14.75	37.52	18.25	0.91	0.32	3.06	1.76	0.55	62.48
	10	9.39	9.02	4.46	14.75	37.51	18.24	0.92	0.33	3.06	1.76	0.55	62.48
	15	9.39	9.02	4.46	14.75	37.51	18.24	0.92	0.33	3.06	1.76	0.55	62.48
FRN	5	7.78	7.78	3.88	19.07	17.77	38.83	1.07	0.19	1.96	1.29	0.38	61.17
	10	7.78	7.78	3.88	19.07	17.76	38.82	1.07	0.20	1.96	1.29	0.38	61.17
	15	7.78	7.78	3.88	19.07	17.76	38.82	1.07	0.20	1.96	1.29	0.38	61.17

Table III Generalized Variance Decompositions (VDCs) (Cont.)

Market Explained	Horizon (in days)	By Innovations in											Foreign Total
		US	CA	MEX	UK	GM	FRN	JAP	TW	HK	SIN	SK	
JAP	5	4.33	4.59	2.49	5.00	3.82	4.47	66.81	0.52	3.79	2.98	1.21	33.19
	10	4.33	4.59	2.49	5.01	3.83	4.47	66.75	0.53	3.80	2.98	1.22	33.25
	15	4.33	4.59	2.49	5.01	3.83	4.47	66.75	0.53	3.80	2.98	1.22	33.25
TW	5	2.41	2.41	1.70	1.44	2.26	1.48	1.10	80.45	2.41	3.02	1.32	19.54
	10	2.45	2.42	1.71	1.46	2.27	1.52	1.10	80.31	2.42	3.03	1.32	19.70
	15	2.45	2.42	1.71	1.46	2.27	1.52	1.10	80.30	2.42	3.03	1.32	19.70
HK	5	7.78	7.03	5.54	6.70	4.68	4.54	2.67	1.00	45.56	12.71	1.79	54.45
	10	7.78	7.04	5.54	6.71	4.68	4.55	2.67	1.02	45.51	12.71	1.80	54.49
	15	7.78	7.04	5.54	6.71	4.68	4.55	2.67	1.02	45.51	12.71	1.80	54.49
SIN	5	7.74	7.05	4.29	5.49	4.14	4.40	2.09	1.09	14.04	47.56	2.10	52.43
	10	7.75	7.07	4.29	5.51	4.16	4.40	2.10	1.09	14.03	47.49	2.11	52.51
	15	7.75	7.07	4.29	5.51	4.16	4.40	2.10	1.09	14.03	47.49	2.11	52.51
SK	5	3.60	5.13	3.06	4.15	3.42	2.74	1.34	0.88	2.70	3.20	69.79	30.22
	10	3.64	5.15	3.07	4.18	3.42	2.74	1.35	0.88	2.71	3.20	69.67	30.34
	15	3.64	5.16	3.07	4.18	3.42	2.74	1.35	0.88	2.71	3.20	69.66	30.34

Note 1: Each entry in the table denotes the percentage of forecast error variance of the market on the left-hand side explained by markets in the top row.

2. Generalized VDCs are standardized for each of the markets explained (first column), thus the total VDC equals 100 percent (Dekker et al., 2001).

3. Entries in the "Foreign Total" (last column) denote the total percentage of forecast error variance of the market in the first column explained by all foreign markets in the top row.

Table IV Correlations of Stock Market Interdependence and Trade Relations

Country	Correlation Coefficients (ρ)[a]		
	VDCs and Exports	VDCs and Imports	VDCs and Total Trade
America			
US	0.80^{*}	0.60	0.70
CA	0.74	0.75	0.75
	(-0.12)[b]	(0.16)[b]	(0.04)[b]
MEX	0.68^{***}	0.67	0.67^{*}
	(0.81^{**})[b]	(0.07)[b]	(0.31)[b]
Europe			
UK	0.78^{***}	0.72^{**}	0.75^{**}
GM	0.86^{**}	0.76^{**}	0.83^{**}
FRN	0.88^{***}	0.81^{**}	0.85^{**}
Asia			
JAP	0.09	0.11	0.10
TW	0.29	-0.27	0.03
HK	0.21	-0.32	-0.01
SIN	0.36	-0.10	0.11
SK	-0.16	-0.23	-0.20

Note a: Correlation coefficients between the VDCs of the stock market of country on the left-hand side and shares of exports, imports, and total trade, respectively, of trading partners out of the country. Asterisks ***, **, and * denote significance at the 5%, 10%, and 20% levels, respectively.

b: Correlation coefficients excluding the stock market interdependence and trade relations of CA and MEX with the U.S. due to their extremely high trade dependence upon the U.S.

Source: In calculating the correlation coefficients, the VDCs of the stock markets are from Table III, and the shares of exports, imports, and total trade are from Table I.