On The Dynamic Relationship Between Exchange Rates And Industry Stock Prices: Some Empirical Evidence From Malaysia

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ABSTRACT

This study examines the dynamic relationships between exchange rate and stock prices at the industry level in Malaysia during June 1996 – August 1998. This study finds a strong relationship between the two series during the financial crisis (July 1997 – August 1998) and differing effects of exchange-rate changes on the performance of stock prices across different industries. In addition, exchange-rate changes have negative effects on some industries (e.g., construction) but positive effects on other industries (e.g., property). Thus, government needs to concentrate on stabilizing the exchange market first while financial managers need to carefully analyze the effects of changes in exchange rates on specific industries to better manage foreign-exchange exposures.

INTRODUCTION

A strong relationship between changes in exchange rates and corresponding domestic stock prices has been frequently discussed in the financial press and empirical studies.[1] Since the exchange rate is used to convert prices denominated in one currency into prices in other currencies, it is closely related to a country's macroeconomic performance, especially to a small, developing economy. At the microeconomic level, exchange-rate changes affect the terms of trade for importers and domestic exporters, which, in turn, affect the firms' competitiveness, profits, and stock prices. Thus, shocks in the foreign exchange markets and their impacts on domestic stock markets are of great concern to financial managers and policymakers. It is of great importance to understand the relations between the foreign exchange market and domestic stock market so that financial managers can better control their foreign exposures whereas policymakers can implement the most effective economic policies. If the foreign exchange market leads the corresponding stock market, government policy should concentrate on stabilizing the exchange market. If the stock market leads the foreign exchange market, consistent economic policies should be implemented to stabilize the domestic economy and its stock market.

In theory, the Goods-Market Approach asserts that changes in exchange rates lead (or Granger-cause) stock prices. As the domestic currency depreciates, domestic products become more competitive in international markets, which increase the value of an exporting firm.[2] On the other hand, the Portfolio Approach asserts that stock prices lead exchange rates. As stock prices increase, domestic assets become more attractive, which, in turn, causes appreciation of domestic currency.[3] Although theories suggest bi-directional causal relations between exchange-rate changes and stock prices, empirical results thus far reveal a weak link between the two series. The main reason for this failure may be due to the fact that most studies used data from developed economies. In general, multinational firms in developed economies are able to more effectively manage foreign exchange exposures by diversifying operating and financing activities across countries.[4] Thus, the foreign exchange exposure (for a firm as a whole) may be small or non-existent due to various forces canceling each other even though a firm's specific economic activity, when examined in isolation, is clearly affected by changes in exchange rates. To date, there has been no study that examined dynamic relationships between exchange-rate changes and domestic stock prices at the industry level in small, open, developing economies.[5]

The objective of this study is to examine the dynamic relationship between exchange-rate changes and stock prices at the industry level in a small, developing economy, specifically Malaysia, around the Asian financial crisis (June 1996 - August 1998). Malaysia is chosen for several reasons. First, firms in developing economies such as Malaysia face more foreign exchange exposures due to the size of trade (relative to GDP) compared to those in developed economies. As open-economy macroeconomics suggests, small and open economies are more sensitive to changes in international conditions, and the dispersions of industry-level exchange-rate exposures vary systematically with the size and openness of the economy. Thus, the robustness of previous studies may be reexamined against evidence from a small, open, developing economy. Malaysia has pursued a trade-promotion policy to stimulate its economic growth. Its trade ratio ranges from 2.069 (1996) to 2.247 (2001), which is much higher than those of developed countries (e.g., the U.S. (0.22); the Netherlands (0.97)).[6] Second, big events such as the Asian financial crisis could have significantly altered the fundamental relationships between the exchange market and domestic stock market in a small, open, developing economy. In particular, Malaysia maintained a managed-floating rate system before and during the financial crisis but adopted a fixed-rate system after the crisis to protect its domestic economy from external shocks.[7] Third, Malaysia is one of the countries that was most affected, mainly due to its proximity to Thailand, by the financial shocks caused by the Thai baht devaluation (June 1997) that triggered the Asian financial crisis.[8]

Malaysia had a unique experience during the Asian financial crisis. The huge capital inflow in the early 1990s, due partly to higher interest rates, resulted in a balance-of-payments surplus, which, in turn, increased domestic liquidity and credit. By the end of 1993, the Central Bank effectively managed the exchange rate through interventions and sterilization by borrowing back the additional liquidity from commercial banks. When the Central Bank changed its policy to allow commercial banks to lend money to the private sector in 1994, bank lending increased as much as 32% over a period of August 1995 - August 1997. As the excessive growth of money and credit was channeled into its economy, Malaysia experienced high inflation, over-investments in some industries (e.g., infrastructure, manufacturing, property, telecom), and bubbles in equity market and real estate. Consequently, international bank debt increased as much as 130% from $12.6 billion (December 1993) to $29 billion (June 1997) because of mounting current account deficits (i.e., 6.4% in 1995 to 8.6% of GNP in 1996) (mainly due to increasing imports of consumer goods) and additional short-term borrowings to finance current account deficits (around $16.1 billion in 1996).[9] As return on investments gradually decreased (partially due to rising interest rates), foreign investors began withdrawing a huge amount of capital from Malaysia. When foreign banks refused to roll over their credits, Malaysia experienced a huge capital flight, massive sell-off of assets, and sharp depreciation of its currency. Furthermore, the baht devaluation by Thailand (July 2, 1997) sent big shocks to Malaysia and other Asian countries. During the financial crisis, the ringgits (RM hereafter) depreciated as much as 49% (RM 2.515 (6/2/97) to RM 4.95 (1/15/98) per U.S. dollar while its stock market fell by 79%. To protect its economy, Malaysia finally pegged its exchange rate at RM 3.76 per U.S. dollar in September 1998.

The observed relationship between the foreign exchange market and stock market in Malaysia suggests that exchange-rate exposure could be more prevalent in a small, open, developing economy, and exchange rates could have differing effects on the performance of stock prices in different industries due to diverse set of influences. Specifically, this study examines the following issues: 1) whether exchange-rate changes lead stock prices; 2) whether changes in exchange rates have differing impacts on the performance of stock prices in different industries; and 3) whether the relationship between exchange-rate changes and stock prices changed during the crisis. To the best of our knowledge, this is the first study to examine dynamic relationships between exchange-rate changes and stock prices at the industry level in a small, open, developing economy.

This study finds a stronger relationship between exchange-rate changes and stock prices during the financial crisis than before the crisis. In most cases, exchange-rate changes lead stock prices by one to three days (supporting the Goods-Market Approach). But the trading-service index leads exchange-rate changes by two days with a negative correlation (supporting the Portfolio Approach). It is also worth noting that exchange-rate changes have differing effects on stock prices across different industries, and their relationships systematically differ across industries. In particular, changes in exchange rates have negative effects on some industries (Construction, Consumer Products) but positive effects on the other industries (e.g., finance, infrastructure, industrial products, plantation, and property). As a whole, exchange-rate changes have negative effects on market indices (Kuala Lumpur Stock Exchange Composite, Second Board, and Exchange Main Board All Share).

This paper proceeds as follows. Section II reviews previous studies. Data and empirical methods are presented in Section III, and empirical findings are discussed in Section IV. Summary and Conclusion follow in Section V.

LITERATURE REVIEW

To date, empirical studies do not find a strong relationship between exchange-rate changes and stock prices. Ajayi and Mougoue (1996), using daily data for eight countries, report weak relations between the foreign exchange markets and domestic stock markets, whereas other studies (Jorion (1990), Bodnar and Gentry (1993), Bartov and Bodnar (1994)) fail to find a significant relation between the two markets. Griffin and Stulz (2001) show that innovations of weekly exchange rates have a negligible impact on the value of industry indexes in most countries.[10]

In a different vein, Ma and Kao (1990) report that a currency appreciation negatively affects the domestic stock market for an export-dominant economy and positively affects the domestic stock market for an import-dominant economy (supporting the Goods Market Approach). According to Nieh and Lee (2001), currency depreciation drags down stock prices in Germany but stimulates stock prices in Canada and UK on the following day, and an increase of stock prices often leads to currency depreciation the next day in Italy and Japan. Abdalla and Murinde (1997) find that a country's monthly exchange rate tends to lead stock prices in four emerging economies (i.e., India, Korea, Pakistan, and the Philippines) over the period of January 1985 – July 1994. Pan, Fok, and Liu (2000), using national stock-market indexes, note that the foreign exchange rates have great impacts on stock prices in seven Asian economies (Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand), and the exchange rates lead stock prices during January 1988 - October 1998, except Malaysia.[11] In the case of Malaysia, Granger, Huang, and Yang (2000) report that 1) there is no causal relation between the foreign exchange market and its stock market during January 1986 - November 1987, 2) the foreign exchange market leads stock market during December 1987 - December 1994, and 3) the exchange market may take the lead and/or lag stock market during January 1995 – November 1997.[12] In sum, empirical studies thus far have not provided conclusive results on the lead/lag relationships between the foreign exchange market and domestic stock market. This study reexamines the dynamic relationship between changes in exchange rates and stock prices. This study differs from prior studies in that we examine the relationship between exchange-rate changes and stock prices at the industry level.

DATA AND METHODOLOGY

As is well documented in the literature, it may not be appropriate to use monthly or weekly data in detecting the effects of capital movement that is intrinsically a short-run phenomenon. To capture such effects, this study uses daily data around the Asian financial crisis (June 1996 - August 1998).[13] This period is chosen due to the fact that major events (e.g., Asian financial crisis) could have significantly altered the fundamental relations between foreign exchange rates and stock prices in a small, open, developing economy, specifically Malaysia. In order to better dissect the relations between exchange-rate changes and stock prices, this period is divided into two sub-periods: June 1996 – June 1997 (before the crisis) and July 1997 – August 1998 (during the crisis).[14]

Since the U.S. dollar is the currency of the largest trading partner, this study uses daily (closing) spot exchange rates (RM/US$) obtained from the Pacific Commerce database.[15] Industry indices are obtained from the Kuala Lumpur Stock Exchange.[16] Following the literature, the logarithms of these variables are used in empirical tests. Table 1 presents daily data of exchange rate and industry indices that are used in this study.

For the whole period, the trading-service industry is most sensitive to changes in exchange rates, followed by Construction and Finance indices. In addition, the Second Board index is more sensitive (-0.208, significant at the 5% level) to exchange-rate changes than the Exchange-Main All-Share index (-0.192, significant at the 10% level). This result is due to the size effect: the market capitalization of firms included in the Second Board index is smaller than firms included in the Exchange-Main All-Share index (see Table 1).[17]

Table 1: Summary Of Market And Industry Indices

Index	Notation	Base Year	Number Of Firms	Ranking According To Total Market Capitalization	Sensitivity To Changes In Exchange Rates
KLSE Composite	KLCI	1986	100	9	-0.247**
Exchange Main All Share	EMAS	1991	597	1	-0.192*
Second Board	SEND	1988	287	10	-0.208**
Construction	CONT	1970	41	8	-0.340**
Consumer Products	CONS	1970	73	7	-0.147*
Finance	FINC	1970	59	2	0.277**
Industrial Products	INDP	1970	129	5	0.183*
Infrastructure	INPC	1970	366	4	0.168*
Plantation	PLNT	1970	39	11	0.143*
Property	PRPT	1970	95	3	0.135*
Trading-Services	TRSV	1970	123	6	-0.834***
Mining	MING	1970	2	12	0.015

Notes:
1. These weighted indices are computed based on market capitalization. For example, Kuala Lumpur Composite Index (KLCI) is computed based on 100 blue-chip stocks as follow:
KLCI = (Current aggregate Market Capitalization)÷(Base Aggregate Market Capitalization)*100.
2. *, **, and *** denote significance at the 10, 5, and 1% levels, respectively. Mining Index is excluded due to the small sample size. Infrastructure (INPC) refers to "infrastructure project firms," which includes 366 technology stocks. The last column shows coefficient b as the sensitivity of each index to changes in exchange rates in the following model: $\Delta I_t = a + b\Delta E_t + e_t$.
3. Some of important developments in securities industry are as follow:
a) 1973: Securities Industry Act enacted;
b) 1984: Formation of Securities Clearing Automated Network Services (central clearing house);
c) 1988: Launch of the Second Board for smaller companies with viable and strong growth potential; foreign ownership in stock broking companies was moderated from 30% to 49%;
2) 1993: Establishment of the Securities Commission;
3) 1996: Minister of Finance approved the listing of foreign companies on KLSE.
4) The (minimum) listing requirements for the Main Board and the Second Board are as follow:
a) Main Board: Minimum paid-up capital (MPUC) of RM 60 million; 25% of MPUC should be in the hand of public shareholders; and minimum RM 30 million after-tax profits over the past three financial years.
b) Second Board: MPUC of RM 40 million; 25% of MPUC should be in the hand of public shareholders; and at least RM 12 million after-tax profits over the past three financial years.

The Granger causality test requires that all data series should be stationary; otherwise the inference might be spurious because the test statistics will have nonstandard distributions. To examine the stationarity of these series (i.e., existence of a unit root), this study uses the Augmented-Dickey-Fuller (ADF) test along with the KPPS test as follow:[18]

$$\Delta y_t = \alpha + \beta(1+\lambda)\, y_{t-1} + \sum_{j=1}^{k} \gamma(1+\lambda)\, \Delta y_{t-j} + \epsilon_t \quad (1)$$

where y is the series being tested, and k is the number of lags to be included to capture any autocorrelation. The dummy variable ($\lambda = 1$ for $j > 245$ (during the crisis); 0 otherwise) is used to capture any changes due to structural breaks in pooling data of the two sub-periods.[19] The lag-length k is chosen so that the Ljung-Box Q-statistic fails to reject the null hypothesis of no serial correlation in the residuals (e). The test is pseudo t-statistic for the null hypothesis of "**b** = 0."

Table 2 shows that the null hypothesis (i.e., a unit root in the level of each series) is not rejected by the ADF test, which is also confirmed by the KPPS test. The results indicate that there is a unit root in all the level series but not in the first-difference series. Thus, the Granger causality test should be conducted on the first-difference series.

Table 2: Results Of Root Tests For Exchange Rate And Indices

The augmented Dickey-Fuller test (Model 1) is used for a unit-root test as follows:

$$\Delta y_t = \alpha + \beta y_{t-1} + \sum_{j=1}^{k} \gamma \Delta y_{t-j} + \epsilon_t$$

where y is the series being tested, and k is the number of lags to capture any autocorrelation

	Test for One Unit Root		Test for Two Unit Roots		KPPS Test
Variables	t-value	Lag	t-value	Lag	Statistic
RM-US Dollar Exchange Rate	-1.170895	5	-16.007**	4	0.176**
KLCI	-1.285045	5	-13.587**	5	0.185**
EMAS	-1.223568	4	-17.794**	5	0.215**
SEND	-0.761281	4	-16.421**	5	0.295**
CONT	-1.187659	5	-14.712**	4	0.242**
CONS	-1.104922	4	-13.983**	4	0.214**
FINC	-1.129861	5	-18.575**	5	0.254**
INDP	-1.246953	4	-12.621**	4	0.276**
INPC	-1.158337	5	-14.331**	4	0.331***
PLNT	-1.089723	4	-16.634**	3	0.249**
PRPT	-1.173085	4	-19.107**	4	0.268**
TRSV	-1.343381	5	-14.121**	5	0.225**

Notes: *, **, and *** denote statistical significance at the 10, 5, and 1% levels, respectively.
The lag-length k is chosen so that the Ljung-Box Q-statistic fails to reject the null hypothesis of no serial correlation in the residuals. The test is pseudo t-statistic for the null hypothesis of "$\beta = 0$". The critical values at the 1, 5, and 10% levels are -3.4408, -2.8654, and -2.5688, respectively. For the ADF tests, the unit-root null is rejected if the value of the Dickey-Fuller (Engle-Granger) t-statistic is less than the critical value. For the KPPS (Kwiatkowski, Phillips, Schmidt, and Shin, 1992) tests, the null of trend stationarity or cointegration is rejected if the value of the KPPS statistic is greater than the critical value.

If two series are integrated with the same order, a linear combination of the two series may eliminate the common component(s) characterizing the two series, resulting in a long-run equilibrium relationship. The market mechanism generating the two series exhibits short-run drifts but approach one another in the long run because the two series are driven by a common I (1) component. The two series (E_t (exchange rate), I_t (indices)) are cointegrated if the difference (i.e., $Z_{t-1} = E_{t-1} - \eta I_{t-1}$) is I (0).[20] In this case, the equilibrium error term (Z_t) is estimated as follow:

$$E_t = a + b\, I_t + e_t \quad (2)$$

where b is an estimate of η and (a + e) provides an estimate of Z_t. If the two series are cointegrated, the ADF test is applied to the residual series (e_t) from Model (2) as follow:

$$\Delta e_t = \omega e_{t-1} + \sum_{j=1}^{k} \omega_j \Delta e_{t-j} + v_t \quad (3)$$

where k is the number of lags to capture the autocorrelation so that the Ljung-Box Q-statistic fails to reject the null hypothesis of no serial correlation in the residual of Model (3).[21] The test is a pseudo t-statistic for the null hypothesis that ω be equal to zero.

Table 3: Results Of Cointegration Tests

Indices	ADF[a]	*k*[b]
KLCI	4.179***	6
EMAS	4.079***	4
SEND	4.262***	7
CONT	4.124***	5
CONS	4.564***	6
FINC	4.459***	6
INDP	4.124***	5
INPC	3.647**	8
PLNT	4.162***	6
PRPT	3.547**	6
TRSV	4.521***	8

Notes: *, **, and *** denote statistical significance at the 10, 5, and 1% levels, respectively.
[a] The ADF numbers are the augmented Dickey-Fuller pseudo *t*-statistics for testing the null hypothesis of $\omega = 0$ in Model (3). The critical values are -4.00, -3.37, and -3.02 at the 1, 5, and 10% levels, respectively.
[b] Lag length *k* is chosen such that the Ljung-Box *Q*-statistic fails to reject the null hypothesis of serial correlation in the residuals of equation (3).

The significant negative coefficients in Table 3 suggest that the null hypothesis of no cointegration between the two series is rejected. Since the two series are cointegrated, the appropriate formulation of a Granger causality test needs to incorporate an error-correction term. Thus, an error-correction term ($Z_{t-1} = E_{t-1} - \eta I_{t-1}$) is included in the Vector Error-Correction (VEC) model.[22] The error-correction term is expected to capture the adjustments of changes in exchange rates and stock prices towards long-run equilibrium.

The VEC model is an econometric model to a theory linking short-run dynamics and long-run relations between two economic variables. Since the VEC model captures partial adjustment one variable makes to shock(s) caused by another variable(s), some proportion of disequilibrium in one period will be corrected in the following periods (Engle and Granger, 1987). This study uses the following VEC model:

$$\Delta E_t = \gamma_1 Z_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta I_{t-i} + \sum_{j=1}^{n} \phi_j \Delta E_{t-j} + \epsilon_{f,t} \quad (4.1)$$

$$\Delta I_t = \gamma_2 Z_{t-1} + \sum_{=1}^{n} \beta_i \Delta I_{t-j} + \sum_{j=1}^{n} \delta_j \Delta E_{t-j} + \epsilon_{s,t} \quad (4.2)$$

where Δ is the first-difference operator, E denotes exchange rate, and I denotes industry indices. The error-correction term ($Z_{t-1} = E_{t-1} \eta I_{t-1}$) is interpreted as stochastic deviations from the long-run equilibrium relationship. The $\epsilon$is stationary random process to capture other pertinent information that is not contained in the lagged values of ΔI_{t-j} and ΔE_{t-j}.[23] The AIC (Akaike, 1969) is used to determine the optimal number of lags (2 to 5) for i and j.

The coefficients α_i and $\delta_j$in Model (4) represent the short-run relationships between the two series. If any α_i is significant, then stock prices lead (in the Granger sense) exchange-rate changes. If any α_j is significant, then exchange-rate changes lead stock prices. The long-run relationship depends on the significance of γ for the error-correction term. Given the error-correction term, an increase in Z_{t-1} resulting from an overvalued E_{t-1} should be followed by a negative change in E_t over the next period. Thus, the sign of the error-correction term (Z_{t-1}) should be positive in Model (4.1) but negative in Model (4.2).[24] The magnitude of significant γ_1 or γ_2 represents adjustment(s) made by one variable to the departures from the equilibrium relationship due to shocks caused by the other variable. After identifying the appropriate lag structure, a seemingly unrelated regression model is used to gain efficiency in estimating Model (4).

EMPIRICAL RESULTS

The results of estimating the VEC model described in Equation (4) are presented in Table 4. Table 4 shows that both γ_1 and γ_2 have the appropriate signs (positive for γ_1 and negative for γ_2), and the significance of these coefficients supports strong bi-directional relationships between the two series. The results indicate that stock prices adjust to the shocks caused by changes in exchange rates and vice versa.

Table 4: Results Of The Vector-Error-Correction Model For The Whole Period

$$\Delta E_t = \gamma_1 Z_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta I_{t-i} + \sum_{j=1}^{n} \Phi_j \Delta E_{t-j} + \epsilon_{1,t} \quad (4.1)$$

$$\Delta I_t = \gamma_2 Z_{t-1} + \sum_{i=1}^{n} \beta_i \Delta I_{t-i} + \sum_{j=1}^{n} \delta_j \Delta E_{t-j} + \epsilon_{2,t} \quad (4.2)$$

where Δ is the first-difference operator, E denotes exchange rate, and I denotes industry indices. The error term ϵ's are stationary random processes to capture other pertinent information, not contained in lagged values (ΔI_{t-j}, ΔE_{t-j}).

Indices	Λ_1 (Z_{t-1})	$\Delta I_t \Rightarrow \Delta E_t$ (α_i sign)[a]	γ_2 (Z_{t-1})	$\Delta I_t \Leftarrow \Delta E_t$ (δ_j sign)[b]	$\Delta I_t \Leftarrow \Delta E_t$ (net effect)[c]
KLCI	0.022***	1 day (-)	-0.013***	2 days (-)	1 day (-)
EMAS	0.018***	0	-0.016***	4 days (-)	4 days (-)
SEND	---	2 days (-)	-0.008***	3 days (-)	1 day (-)
CONT	---	1 day (-)	-0.009***	2 days (-)	1 day (-)
CONS	0.015**	1 day (-)	-0.028***	3 days (-)	2 days (-)
FINC	0.016***	4 days (+)	-0.019***	6 days (+)	2 days (+)
INDP	0.018***	3 days (+)	-0.024***	5 days (+)	2 days (+)
INPC	0.016**	0	-0.024***	2 days (+)	2 days (+)
PLNT	---	1 day (-)	-0.019***	3 days (+)	2 days (+)
PRPT	0.014**	2 days (+)	-0.018***	5 days (+)	3 days (+)
TRSV	0.013**	3 days (-)	-0.014***	1 day (+)	-2 days (-)

Notes: *, **, and *** denote significance at the 10, 5, and 1% levels, respectively.

a, b: "$\Delta I_t \Rightarrow$ (or $\Leftarrow$) ΔE_t" [n days (+ or -) in Column 3 and Col. 5] suggests that index leads (or lags) exchange rate by n days with a positive (or negative) correlation. The positive (or negative) signs are determined by the difference between the sums of all positive coefficients and that of all negative coefficients.

c. Column 6 shows the net effect between the two coefficients (α_i's, δ_j's) as the net difference (Col. 5 – Col. 3). The positive (+) (or negative (-)) number of days suggests that indices lead (or lag) the exchange rate with positive (+) (or negative (-)) correlations. For example, the exchange rate leads KLCI by 1 day with a negative correlation.

The last column of Table 4 (labeled "net effect") reveals several interesting results. First, changes in exchange rates lead stock prices by one day in the case of KLCI, SEND, and CONT, two days in the case of CONS, and four days in the case of EMAS. In these cases, the temporal relationship between the two series is negative, which indicates that the depreciation of RM (i.e., increasing exchange rate) exerts downward pressure on stock prices. The negative relationship may be due to the fact that as RM depreciates, profits of importing firms (e.g., CONT, CONS) decline because of higher imported prices. The negative effect clearly shows that industries that heavily rely on internationally-priced inputs experience decreasing profits as RM depreciates. This result supports the Goods-Market Approach. Second, changes in exchange rates lead stock prices by two days in the case of FINC, INDP, INPC, and PLNT, and three days in the case of PRPT. In these instances, the positive temporal relationship indicates that as domestic products become more competitive in the international markets due to the depreciation of RM, higher profits increase the value of exporting firms (e.g., INDP, INPC, PLNT). In contrast, the trading-service index leads exchange-rate changes by two days with a negative correlation. This result supports the Portfolio Approach. The negative relationship indicates that an increase of stock prices in trading-service industry exerts downward pressure on exchange rates, which decreases the exchange rate (i.e., appreciation of RM). This may be due to the long-term nature of business practices (e.g., six-month to one-year contracts) in this industry: making long-term contracts would increase (future) cash flows, which, in turn, causes appreciation of RM.

The most noteworthy feature is that the lead/lag relationships between the two series are not consistently related to the ranking of industry indices based on market capitalization. The size effect is clearly revealed in the case of a negative temporal relationship: changes in exchange rates lead the large-cap indices longer (i.e., four-day lead for EMAS) compared to those of small-cap indices (i.e., one-day lead for SEND and CONT).[25] However, it is not clear in the case of the positive temporal relationship: exchange-rate changes lead two days in the case of FINC (large-cap), INDP, INPC, and PLNT (small-cap) and three days in the case of PRPT (large-cap). In sum, these results clearly show that industry stock prices are more affected by changes in exchange rates. The magnitude of the *F*-statistic (not reported here) further supports a strong causal relationship from exchange-rate changes to stock prices than the other way around.

Table 5: Results Of The Vector-Error-Correction Model Before The Financial Crisis

Indices	γ_1 (Z_{t-1})	$\Delta I_t \Rightarrow \Delta E_t$ (α_i sign)[a]	γ_2 (Z_{t-1})	$\Delta I_t \Leftarrow \Delta E_t$ (δ_j sign)[b]	$\Delta I_t \Leftarrow \Delta E_t$ (net effect)[c]
KLCI	-0.016**	0	---	0	0
EMAS	---	0	0.015*	2 days (-)	2 days (-)
SEND	-0.025***	0	---	0	0
CONT	---	0	---	1 day (-)	1 day (-)
CONS	---	0	---	2 days (-)	2 days (-)
FINC	---	0	---	2 days (-)	2 days (+)
INDP	-0.006**	0	---	2 days (-)	2 days (+)
INPC	---	0	0.117***	2 days (-)	2 days (+)
PLNT	---	0	---	2 days (+)	2 days (+)
PRPT	-0.025**	1 day (-)	---	2 days (-)	1 day (+)
TRSV	-0.034**	3 days (-)	---	1 day (-)	-2 days (-)

Table 5 provides empirical results for the pre-crisis period (June 1996 – June 1997). The results are similar to those in Table 4 with several noteworthy observations. Similar to the whole period, the significance of γ_1 and γ_2 supports a bi-directional relationship between the two series. In most cases, changes in exchange rates lead (or Granger-cause) stock prices: exchange-rate changes lead stock prices by one day in the case of CONT and two days in the case of CONS and EMAS with a negative correlation. But exchange-rate changes lead stock prices by one day in the case of PRPT and two days in the case of FINC, INDP, INPC, and PLNT with a positive correlation. In contrast, the trading-service index leads changes in exchange rates by two days with a negative correlation.

Table 6 provides empirical results during the financial crisis (July 1997 – August 1998). The significance of γ_1 and γ_2 again supports a bi-directional relationship between the two series in this period. The results clearly show that changes in exchange rates lead stock prices by one day in the case of KLCI and SEND and two days in the case of CONT, CONS, and EMAS with a negative correlation. But changes in exchange rates lead stock prices by one day in the case of PRPT, two days in the case of FINC and INDP, and three days in the case of INPC and PLNT with a positive correlation. As an exception, the trading-service index leads changes in exchange rates by one day with a negative correlation.

Table 6: Results Of The Vector-Error-Correction Model During The Financial Crisis

Indices	γ_1 (Z_{t-1})	$\Delta I_t \Rightarrow \Delta E_t$ (α_i sign)[a]	γ_2 (Z_{t-1})	$\Delta I_t \Leftarrow \Delta E_t$ (δ_j sign)[b]	$\Delta I_t \Leftarrow \Delta E_t$ (net effect)[c]
KLCI	-0.025**	0	---	1 day (-)	1 day (-)
EMAS	-0.015**	0	0.021**	2 days (-)	2 days (-)
SEND	-0.021**	0	---	1 day (-)	1 day (-)
CONT	-0.009*	0	---	2 days (-)	2 days (-)
CONS	---	0	---	2 days (-)	2 days (-)
FINC	---	0	---	2 days (-)	2 days (+)
INDP	-0.016**	0	---	2 days (-)	2 days (+)
INPC	-0.014*	0	---	3 days (-)	3 days (+)
PLNT	-0.012*	0	---	3 days (+)	3 days (+)
PRPT	-0.034**	2 days (-)	---	3 days (-)	1 day (+)
TRSV	-0.045**	2 days (-)	---	1 day (-)	-1 day (-)

Notes: *, **, and *** denote significance at the 10, 5, and 1% levels, respectively.

a, b: "$\Delta I_t \Rightarrow$ (or $\Leftarrow$) ΔE_t" [n days (+ or -) in Column 3 and Col. 5] suggests that index leads (or lags) exchange rate by n days with a positive (or negative) correlation. The positive (or negative) signs are determined by the difference between the sums of all positive coefficients and that of all negative coefficients.

c. Column 6 shows the net effect between the two coefficients (α_i's, δ_j's) as the difference (Col. 5 – Col. 3). The positive (+) (or negative (-)) number of days suggests that indices lead (or lag) the exchange rate with positive (+) (or negative (-)) correlations. For example, the exchange rate leads KLCI by 1 day with a negative correlation.

In summary, these results clearly indicate that stock prices are more affected by exchange-rate changes, and that stock prices make adjustments to the shocks caused by exchange-rate changes in one to three days. The magnitude of the *F*-statistic also supports that the causal relationship from exchange-rate changes to stock prices is stronger than that from stock prices to exchange-rate changes. In particular, exchange-rate changes lead stock prices by one day in the case of KLCI and SEND during the crisis, compared to no-lead before the crisis. And the trading-service index leads exchange-rate changes by one day during the crisis, compared to a two-day lead before the crisis. As a whole, these results clearly show that the uni-directional causality from exchange-rate changes to stock prices becomes stronger during the crisis than before the crisis.

SUMMARY AND CONCLUSION

This study examined the dynamic relationships between exchange-rate changes and stock prices at the industry level in Malaysia around the Asian financial crisis. This study finds that 1) there exist significant feedback relationships between exchange-rate changes and stock prices for the whole period, 2) changes in exchange rates have differing effects on stock prices across different industries, and 3) changes in exchange rates have negative effects on some industries but positive effects on other industries. In most cases, exchange-rate changes lead stock prices by one to three days (supporting the Goods-market Approach). In contrast, the trading-service index leads exchange-rate changes by two days with a negative correlation (supporting the Portfolio Approach). Of particular interest, the size effect (based on market capitalization) is not consistently related to the lead or lag relationships at the industry level. These results suggest that government needs to concentrate on stabilizing the exchange market first, and financial managers need to carefully analyze the impacts of exchange-rate movements on stock prices in specific industries to better manage their foreign exchange exposures.

Our findings are consistent with those reported by some studies (e.g., Abdalla and Murinde (1997), Granger, Huang, and Yang (2000)) in the sense that exchange-rate changes lead stock prices. However, our results differ from other studies (Jorion (1990), Bodnar and Gentry (1993), Bartov and Bodnar (1994), Ajayi and Mougoue (1996), Griffin and Stulz (2001)) that show exchange-rate changes having negligible impacts on stock prices.

SUGGESTION FOR FUTURE RESEARCH

This study suggests that there is more to be gained from an examination of the relationship between exchange-rate changes and stock prices by using data from small, open, developing economies with differing degrees of market development and openness.

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ENDNOTES

1. See *Business Week* (p. 128, 2/21/2000; p. 157, 12/4/2002), *Wall Street Journal* (4/19/1995, 10/7/1997, 3/8/2000), and *Investors' Edge* (June 2001, Malaysia). For empirical studies, see Jorion (1990), Bahmani-Oskooee and Sohrabian (1992), Bodnar and Gentry (1993), Amihud (1994), Bartov and Bodnar (1994), Bartov, Bodnar, and Kaul (1996), and Bodnar and Wong (2000), and Gao (2000), among others
2. See Dornbusch and Fisher (1980) for the Goods-Market Approach. Abdalla and Murinde (1997) provide empirical results that support this approach in India, Pakistan, the Philippines, and Korea during January 1985 – July 1994.
3. In this framework, changes in exchange rates reflect more of capital movements (due to investors' portfolio rebalance) than current account imbalance. Thus, changes in stock prices may affect exchange rates and money demand because investors' wealth and liquidity demand depend on the performance of the stock market (Gavin (1989)).
4. Multinationals can reduce foreign exchange exposures by diversifying operating activities (e.g., location of production and markets) and by using a variety of financial hedging contracts (e.g., forward, futures, option, and swap). This type of diversification provides hedging to reduce the adverse impacts of exchange-rate changes on firms' operations.
5. Among others, Khoo (1994) notes that the Australian mining companies are sensitive to exchange-rate changes. Bartov and Bodnar (1994) find weak relations between exchange-rate changes and stock returns. Griffin and Stulz (2001) report a negligible impact of weekly exchange-rate innovations on the value of industry indexes in most countries.
6. The openness of an economy is measured by the international trade ratio ((export + import) / GDP). These data are obtained from Department of Statistics (Malaysia) and United Nations.
7. During this period, Korea adopted the floating-rate system whereas Hong-Kong and Singapore maintained the managed-floating-rate system.
8. After spending $7 billion in reserves on the currency spot market and committing $23 billion to the forward markets, Thailand finally made its baht floating in July 1997. This sent big shocks to several Asian countries (e.g., Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, Korea, and Taiwan). When Hong Kong increased its short-term interest rate in October 1997 to maintain its pegged exchange rate to the US dollar, the Hang-Seng Index fell 1,438 points. By December 1997, the Korean Won depreciated against the US dollars by 56% (Won 880 to Won 2,000) while the Korean stock market fell as much as 50%.
9. The short-term borrowing ratio (relative to foreign reserve) increased from 22% (December 1993) to 50% (June 1997).
10. Jorion (1990) reports only a moderate relation between stock return of U.S. multinationals and the trade-weighted U.S. dollar exchange rate over the period of 1971 – 1987.
11. These seven economies are significantly different in terms of the size of each economy, degree of development, rate of growth, and maturity of financial markets. Their results strongly support bi-directional

relations between the two markets in these economies for the whole period. However, they do not find any causal relation between the two markets during the financial crisis in Malaysia.

12. Other noteworthy findings of Granger, Huang, and Yang (2000) are: 1) there exist strong feedback relations in which the exchange market takes the lead and lag stock market in the case of Indonesia, Korea, and the Philippines; 2) the exchange market leads stock markets in the case of Japan, Thailand, Singapore, and Hong Kong; and 3) stock market leads the exchange market in the case of Taiwan.
13. On the other hand, using daily data is beset with having fat-tails, non-normality, and volatility clustering. Our data exhibit slightly positive skewness, and moderately "heavy-tailed," but no volatility clustering. Thus, the reported results are qualitatively the same, compared to those of adjusted series. We give thanks to the editor for pointing out the econometric challenges in using daily data.
14. Since the RM was pegged at 3.76 (per US $) in September 1998, the sample period runs from June 1996 through August 1998.
15. The data are obtained from Pacific Exchange Rate Service (Pacific Time). The trade-weighted exchange-rate index is not used because it may understate the foreign exposures of domestic firms (de Jong, Ligterink, and Macrae, 2002).
16. These weighted indices are computed based on the total market capitalization of each index. See Table 1 and the Kuala Lumpur Stock Exchange Information Book regarding how these indices are computed.
17. Table 1 presents the minimum listing requirements for the Main Board and the Second Board.
18. Due to the lower power of the ADF test, it is suggested to use the KPPS test (Kwiatkowski, Phillips, Schmidt, and Shin, 1992). In comparison, the null hypothesis of the ADF test (Dickey and Fuller, 1979) is the existence of a unit root whereas that of the KPPS test is that the series be stationary (i.e., no unit root).
19. As Perron (1990) indicates, the existence of a structural change (e.g., stock market crash, currency crisis) in a stationary time series would bias the usual unit root tests toward non-rejection of the unit-root hypothesis. To circumvent this problem, we follow Perron's approach by including a dummy variable. The results (not reported here) assert that the conclusion about stationarity for these data remains unchanged even with a dummy variable.
20. If two series are cointegrated, the OLS regression may be biased toward higher R2, lower Durbin-Watson statistics, and lower standard errors, resulting in invalid statistics of t- and F-values.
21. This model does not include an intercept term because the residuals have a zero mean by construction. The null hypothesis of no cointegration is rejected if the pseudo t-statistic is negative and greater than the critical value.
22. The results (not reported) of Johansen's maximum likelihood test (1988) support the cointegration between the two series. Granger (1988) notes that any causality tests may reach incorrect conclusions without an error-correction term.
23. A lag order of five (i.e., $n = 5$) is used due in consideration of five trading days in a week.
24. The two-factor asset-pricing model can be used to gain more insights by adding contemporaneous values of national or global index returns (e.g., MSCI World Index) and exchange-rate changes. However, this study does not examine the pricing of exchange risk in asset market. We give thanks to the editor and anonymous referees for this comment.
25. See Table 1 for the specific rankings of all the industry indices based on market capitalization.

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