Testing Four Strong Behavioral Hypotheses about the Effects of Asian and Russian Crises on Asian Financial Markets

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It has frequently been argued that financial markets behaved irrationally during the Asian and Russian Crises resulting in damaging speculative attacks on innocent victims. This paper tests four popular hypotheses about the behavior of stocks and bonds indices of the Asian crisis countries and finds that these behavior claims do not fit the data during the Asian crisis. However, the paper does find some supporting evidence for the later Russian crisis. The paper calls for the need to develop more nuanced hypotheses about possible imperfect financial market behavior in developing countries.

INTRODUCTION

A decade after the Asian financial crisis, many questions, especially questions regarding global investors' behavior during the crisis, remain unanswered. Most crises are associated with domestic economic and financial weaknesses (Kaminsky, 2003). The unusual characteristic of the Asian crisis is that the 1997-1998 meltdowns struck a group of countries with seemingly impressive economic growth, balanced government budgets, and conservative monetary policies. Shocked by the suddenness and devastation of the event, some started to analyze the impact of market psychology and global investors' behavior during the crisis. Words such as "panic," "contagion," "overreaction," and "victims" frequently appeared in news reports and research papers. In a way, the Asian financial crisis has brought behavioral finance into the study of international finance.

The "Asian flu" refers to the currency crisis in Thailand spreading to the rest of East Asia (Forbes, 2004). The domino-like economic setbacks during the crisis has led many economists to assume that volatility spillovers were mostly neighborhood effects caused by similarities among crisis countries. Therefore, when the Russian crisis hit in August 1998, it was quickly linked to the Asian crisis as a continuous spread of irrational behavior from Asia to Russia. However, the significant deterioration of the financial and real sectors of the Russian economy and the global impact of the Russian crisis had many reconsider the direction of the spread.

Examining stock and bond indices of the crisis countries, this study tests four behavioral hypotheses of the Asian and Russian financial crises. Test results show that there was no evidence of blind panic, contagion, undifferentiated risk perception, or overreaction among crisis stocks. On the contrary, crisis stocks had been good indicators of gradual weakening of the corporate and financial sectors of the crisis countries. There may have been some contagion to Asian bond markets when Russia defaulted its debt in late 1998. Investors did not treat Asian bonds with the same risk perception when the crisis first began in the region, but they increased risk premiums to all crisis bonds soon after the Russian crisis started.

REVIEW OF FOUR BEHAVIOR CLAIMS ABOUT THE ASIAN FINANCIAL CRISIS

A number of commentators have argued that domestic economic conditions did not justify the speed and the depth of the Asian crisis (McKibbin & Martin, 1999). They suggested that global investors' irrational behavior helped spread the crisis to Asian countries with strong economic fundamentals. Such views were particularly prevalent in early analyses of the crisis. Later, analyses have tended to consider a broader range of fundamentals including large current account deficits and financial sector problems and thus suggest that it is not so clear that the crisis countries were innocent victims of irrational behavior by global financial markets.

The Blind Panic and the Irrational Speculator Views

One popular explanation of the crisis was that panic and destabilizing speculations prompted unjustified attacks on innocent victims.

Shocked by the magnitude and speed of the dramatic loss in Asia, some concluded that "panic selling drove prices lower," and that what happened in one country "spooked investors into panic" in another (Emerging Stock Markets Factbook, 1998). According to Radelet and Sachs (2000), investor panic was an important cause for the crisis. Park and Song (2001) argue that countries such as Korea were pure victims of the panic reaction. In their view, the creditors panicked after witnessing the crisis in Taiwan and Hong Kong, and refused to roll over the short-term debt to Korea. Another version of victimization was offered by the Prime Minister of Malaysia Dr. Mohamad Mahathir who blamed international financier George Soros for destroying the Malaysian economy. To defend against what he saw as irrational speculative attacks, Mahathir did not seek IMF financial assistance and reforms. Instead he imposed controls on the flows of capital in and out of the country.

The Undifferentiated Risk Perceptions

Another popular view is that investors didn't do enough homework and failed to differentiate among individual Asian assets. Thus, some combination of lack of in-depth research and moral hazard led to excessive capital flows before and during the Asian crisis.

In the view presented by Willett et al. (2005), the markets reacted sensibly to developments in policy reforms and macroeconomic fundamentals for which information was easily available. But investors did not do enough work to uncover dissimilar financial sectors and potential over-lending problems, for which information was not easily obtained. Thus, global investors had undifferentiated risk perceptions toward Asian assets. They had "excessively low" risk perceptions for all Asian bonds. An alternative, potentially complementary view is that risk perceptions became "excessively high" during the crisis (Sy, 2001). Finding that cross-country sovereign spread correlations were high during the crisis, Baig and Goldfajn (1999) conclude

that "the global investors treated these five countries' financial fragility with a broad stroke by demanding high risk premiums for all of them during the crisis." Mishkin (2003) points to the role of asymmetric information that led investors to magnify relatively small risks in all Asian countries during the crisis.

The Overreaction and Roller Coaster View

Another possibility is that the market behaved like a roller-coaster ride during the crisis. The market was initially inefficient with a bubble. If the bubble burst, excessive optimism would be replaced with excessive pessimism. Such an overreaction, or bandwagon effect, would lead to a fall that overshot the equilibrium level, setting the market off onto a roller-coaster ride up and down.

When applied to the Asian crisis, overreaction leads to losses beyond what can be justified by fundamental weaknesses. Overreactions usually are corrected fairly quickly. Large deviations from long-term averages during a crisis may be an indication of investors' overreaction if the market returns to/toward the mean shortly after.

A number of studies found mean reversions shortly after the Asian crisis, which led some to conclude that the crisis had only temporary effects. Fujii (2002) shows the real exchange rates in Asia displayed mean reversion. This is consistent with the view that investors overreacted, causing exchange rate overshooting. Malliaropulos and Priestley (1999) also find evidence of mean reversion in Asian stock markets. It is commonly known that emerging stock markets tend to fall precipitously during a crisis while taking longer to recover, three to four years on average (Patel & Sarkar, 1998). Overreaction is not the only possible explanation for mean reversion, but when several countries' securities all recover to their means quickly; it strongly suggests that investors overreacted during the crisis. If no such short-term mean reversion occurs, overreaction is unlikely to have taken place.

The Contagion View

The three views described above are conceptually different, but their behavioral phenomena are observationally equivalent. Since these behaviors and other types of market psychology all cause asset returns to move together, this paper further tests the presence of contagion during the crisis.

In psychology, contagion refers to the spread of a behavior pattern, attitude, or emotion from person to person or from group to group through suggestion, propaganda, rumor, or imitation. Panic, undifferentiated risk perception, or overreaction can be spread or imitated. In economic terminology, contagion refers to the spread of a crisis from one country to others (Hernández & Valdès, 2001).

Contagion can be caused by imperfect market behavior such as irrational panic, overreaction, herding, or by rational responses to financial and economic interdependence (Liang & Willett, 2008). A large number of studies have tested the presence of contagion in foreign exchange, bond, and stock markets in Asia. Initial studies usually find evidence of contagion. Later ones have found mixed results.

DATA

This paper analyzes stock and bond country indices of Thailand, Malaysia, Indonesia, the Philippines, and Korea (hereafter referred to as "the Crisis Five" countries). Five S&P Global

(S&P/IFCG) Stock Indices are from the Emerging Markets Database (EMDB) and four[1] Emerging Market Bond Index (EMBI) Global Indices are from J.P. Morgan. All analyses are performed using total returns denominated in U.S. dollars.

METHODOLOGIES

The study first defines decline periods to identify the Crisis Five's financial distress. It then analyzes statistical characteristics of stock and bond indices during different decline periods to study the existence of panic and overreaction. It tests contagion and undifferentiated risk perception using a variety of correlation measurements.

Identification of Non-decline vs. Decline Periods

Since there were different onset points for different countries during the Asian financial crisis, it is difficult to define exactly when the crisis started or ended. Many scholars have used the depreciations of Asian currencies as indicators of the onset of the currency crises, which is a useful definition when analyzing currency market behavior. The purpose here, however, is to analyze the behavior of the Crisis Five's stocks and bonds. These assets, while sharing similar patterns to those of currencies, also possessed unique characteristics. For example, the Crisis Five's stock indices experienced declines long before the Thai Baht devaluation. Yet, both bonds and stocks did not reach their minimum points until the end of September 1998.

Unlike earlier studies addressing the Asian financial crisis as a currency crisis, this paper defines the time the crisis stocks and bonds under financial distress as "decline" periods. It separates the non-decline from decline periods for Asian assets in two ways. Examined first is the descriptive behavior of bonds and stocks. Then the CUSUM of squares test is used as an alternative method to determine when the financial distress begins and ends. Results from two methods are compared, and final analyses are made based on both sets of outcomes.

CUSUM of Squares Test: Structural breaks are used to clarify non-decline vs. decline periods of Asian assets. The Chow test is commonly used for testing structural breaks. But it requires prior knowledge of the breakpoints. Asian foreign exchange markets had given out a clear signal of the crisis as early as 2 July 1997. But stock and bond markets did not show a common sign of distress. To detect significant changes in those assets, the CUSUM of squares test is used to allow data to determine its own breakpoints. Two-year daily data (1997-1998) is employed.

The squared CUSUM test (Brown, Durbin & Evans, 1975) uses the cumulative sum of the recursive residuals from the recursive least squares. The test statistic follows:

$$S = \sum_{r=k+1}^{t} \omega_r^2 \Big/ \sum_{r=k+1}^{T} \omega_r^2$$

Where ω is recursive residuals, T is a total sample size, t is a sub-sample size and k is a number of estimated coefficient.

Tests of Panic and Overreaction

Since one cannot separate effects caused by different behavioral claims described above, a direct hypothesis testing becomes almost impossible. In order to validate the existence of these

[1] EMBI Global does not carry Indonesia.

behavioral claims, this paper takes a bottom-up approach to test implications of panic and overreaction by investigating statistical characteristics of stock and bond returns.

Tests of Contagion Effects and Undifferentiated Risk Perception

A wide range of definitions and testing methodologies of contagion exists. One commonly used method is to calculate co-movements among assets. General co-movements of asset returns measure whether changes of financial assets in one country will lead to changes in another. Existence of such interrelated relationships maybe caused by shared fundamentals, a common third party across several countries, or may be the result of global investors' irrational behavior. This paper refers to this high degree of general co-movements among assets as "interdependence," which is measured by simple correlation coefficients of asset returns.

This paper defines contagion as excess co-movements of asset returns that cannot be explained by common factors or shared fundamentals. There is considerable disagreement regarding the definition of fundamentals. Scholars often construct a set of explanatory variables to measure the long-term effect of fundamentals (Eichengreen, Rose & Wyplosz, 1996). This method is useful when monthly, quarterly, or annual data are used. But it is difficult to observe the impact of macroeconomic fundamentals on daily data. When encountering high frequency data, some have used a benchmark, either a global composite index or a US stock index, such as the S&P 500, to proxy fundamentals (Baig & Goldfajn, 1999). However, emerging market data are often non-linear and non-normally distributed. Statistical results from a simple linear regression cannot capture the dynamic relationship among emerging assets. Thus, instead of explicitly modeling fundamentals, researchers try to capture fundamentals with a set of latent factors (Dungey, Fry, Gonzalez-Hermosillo & Martin, 2005) or with lagged structures to avoid omitted variable bias.

An autoregressive model - VAR is used here to model high frequency daily data. The mathematical form of a VAR (Sims, 1980) is:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + Bx_t + \varepsilon_t$$

Where y_t is a k vector of endogenous variables, which include all bond and stock indices, x_t is a d vector of exogenous variables. $A_1,...,A_P$ and B are matrices of coefficients to be estimated. After fundamentals and common factors are captured by VAR, the residuals represent the idiosyncratic factor of each asset. Correlation coefficients of these residuals capture the excess co-movements, or the contagion effects among assets.

Forbes and Rigobon (2002) argue that correlations are positive functions of volatility. They suggest calculating unconditional correlations to scale down the upwards bias of estimated correlation due to increased volatility during a crisis.

The unconditional correlation is calculated as:

$$v_y = \frac{\rho_y}{\sqrt{1 + (\frac{\sigma_{y,i}^2 - \sigma_{x,i}^2}{\sigma_{x,i}^2})(1 - \rho_y^2)}}$$

Where ρ_y is the correlation during the crisis period, ν_y is the unconditional correlation during the crisis period, and $\sigma^2_{y,i}$ and $\sigma^2_{x,i}$ are the variances of asset returns during the crisis and non-crisis periods.

T and Forbes-Rigobon (FR) t statistics are tested at the five percent level to validate whether there are significant differences among crisis vs. non-crisis correlations.

The paper also uses both simple and VAR residual correlations to study investors' risk perceptions.

Summary of Methodologies

This article first uses both descriptive and CUSUM of squares tests to identify structural breaks of the Asian financial assets; these breakpoints are used to determine the decline vs. non-decline periods for crisis countries' stocks and bonds during the period of financial distress. The study then investigates statistical characteristics of asset returns to test the implications of the panic and overreaction hypotheses. It further calculates simple correlations, VAR residual correlations, and unconditional residual correlations to evaluate interdependence and contagion effects of asset returns, and to examine investors' risk perceptions. Thus, there are three sets of measurements of co-movements of asset returns – general co-movements, co-movements after controlling for common factors, and co-movements after controlling for both common factors and volatilities. Analyses and comparison of these measurements will provide a comprehensive study of contagion effects and investors' risk perception during the Asian and Russian crises.

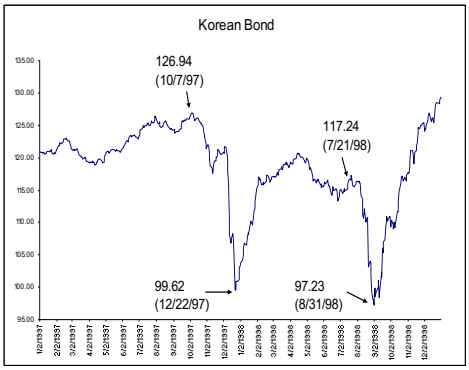
EMPIRICAL RESULTS

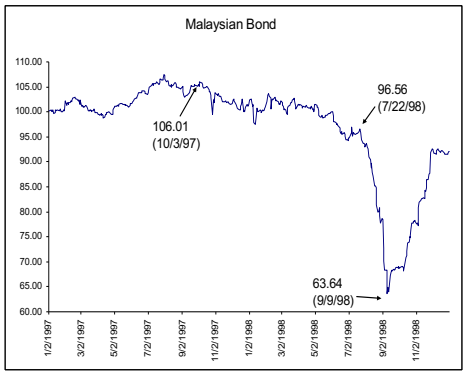
Empirical results show that decline periods defined from the descriptive analysis and the CUSUM of squares test are almost identical. Testable implications reject all behavioral claims among Asian crisis stocks, but cannot reject them among Asian crisis bonds when the Russian crisis struck.

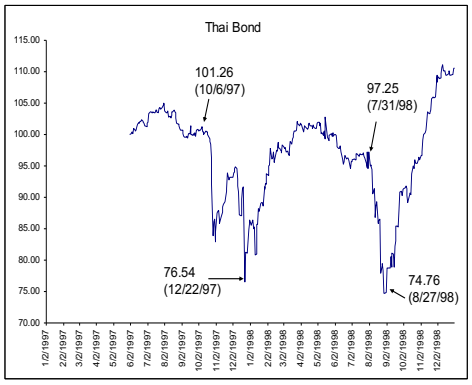
Decline vs. Non-Decline Periods

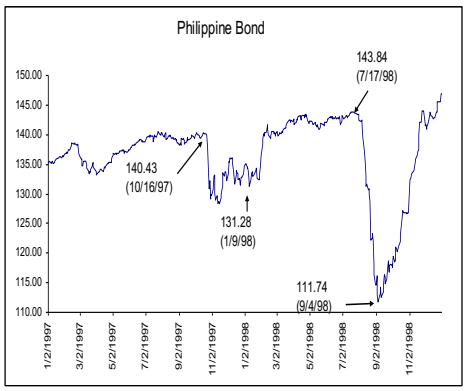
The decline period for Asian stocks is defined as from 22 January 1997 to 21 September 1998. This is determined from the first country's stock index reaching a maximum before a big decline in early 1997 (Thailand, 22 January 1997) to the last country's index falling to a minimum (Korea and Indonesia, 21 September 1998) in the autumn of 1998. Based on the two cycle patterns of all indices, the study separates this long recession into two sub-periods. The first decline is from 22 January 1997 to 23 January 1998, and the second is from 23 March 1998 to 21 September 1998. Based on the same method, the decline period for bonds is defined as from 3 October 1997 to 9 September 1998. This also can be separated into two sub-periods: the first from 3 October 1997 to 9 January 1998, and the second from 17 July 1998 to 9 September 1998 (Figure 1).

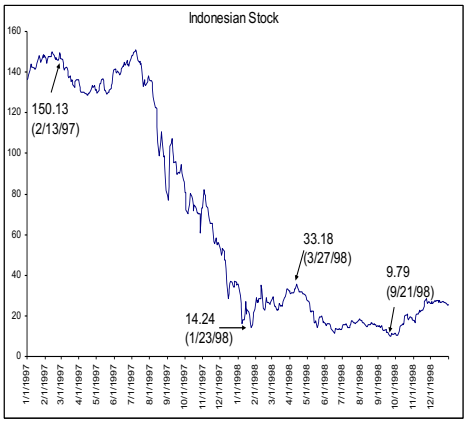
FIGURE 1
STRUCTURAL BREAKS FROM DESCRIPTIVE ANALYSES

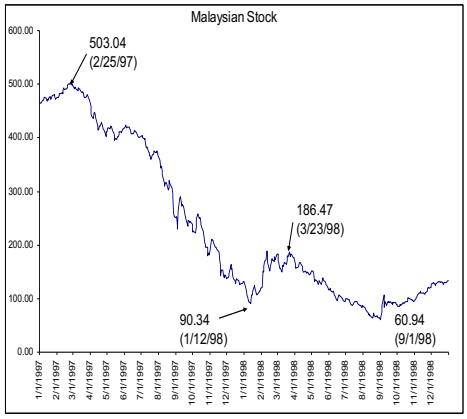


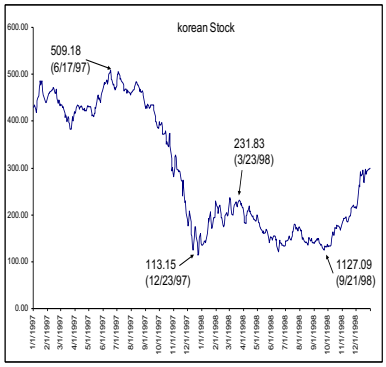


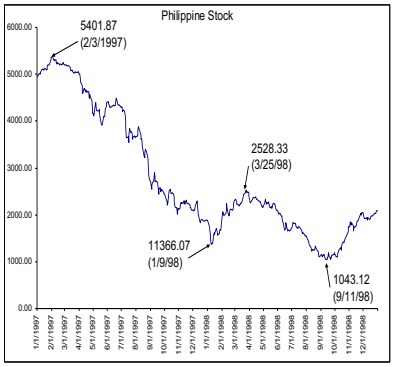


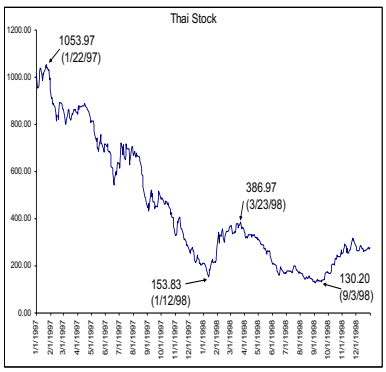












One may apply a more objective method to determine a set of breakpoints by using the CUSUM of Squares Test. The squared CUSUM graph plots the proportional relationship of the cumulative sum of residual squares of the sub-sample to the total sample with the five percent critical lines. The test finds parameter instability if this proportional relationship goes outside of the critical range (Figure 2). The differences between the descriptive and the CUSUM squares results are minor. Most breakpoints derived from the two methods match, with the exception of July 1997 for stocks and March 1998 for bonds. To test the robustness of the results, different breakpoints derived from the CUSUM of squares are used to conduct sensitivity analyses. In addition, October 1997 and August 1998 are also used to study shocks transmitted from Hong Kong and Russia.

The Blind Panic and Irrational Speculator Views

Stocks: In the long run (1990-2005), the Crisis Five's stock indices behave differently. Philippine and Thai stocks were quite volatile, experiencing bubble-like increases during 1994-1996. Korean stocks had been increasing steadily since 2000, while Indonesian and Malaysian stocks had not changed much (Figure 3). Most of the crisis countries' indices offered slightly higher returns than that of the MSCI All County World (MSCI AC WORLD) Index, but their volatilities were two to three times higher (Table 1).

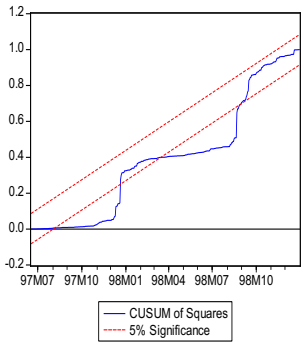
However, the crisis stocks followed somewhat similar patterns during 1997-1998 (Figure 4). All five stocks had twice experienced long and gradual declines. Daily data show that most stock indices started to decline before the Thai Baht unraveled. In fact, the Thai index started to fall as early as in May 1996. Philippine, Korean, Indonesian, and Malaysian stocks started to decline in February 1997. The first cycle of long decline lasted until January 1998 (except that Korean stock declined until December 1997). All series recovered slightly in the beginning of 1998, but dropped to new lows again in six months. Comparing to MSCI AC WORLD Index or the S&P 500 Index, all five Asian indices (except Korean) offered global investors lower returns and much higher volatilities during 1997-1998 (Table 1).

Although most stocks eventually hit the bottom in September 1998, the first decline lasted much longer than the second one, and the impacts were much more severe, accounting for more than 90 percent of the total loss during the crisis. The severity of such a huge loss of wealth promoted panic or irrational speculative attack views of the Asian financial crisis. However, if these views were true, one should have observed significant decreases in stock returns within a very short time frame, beginning from the moment when the currency crisis hit. But statistics show that most stock indices experienced declines long before the Thai Baht devalued.

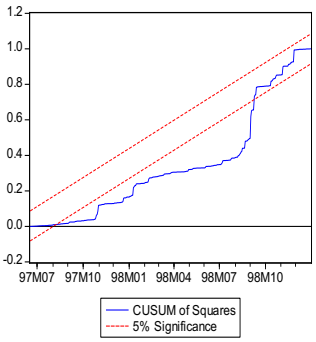
In other words, Asian stock markets had responded to the weakening of financial and corporate sectors of the crisis countries well before the major currency devaluations. For example, the equity in Indonesia fell in March 1997 "after various companies reported disappointing profits" and "after great concerns about earning prospects in the bank sectors" (Emerging Stock Markets Factbook, 1998). The equity market in Korea had been brought down by numerous corporate bankruptcies and labor strikes. The fact that changes of stock prices followed changes in these countries' fundamentals raises serious doubts about the panic theory.

FIGURE 2
STRUCTURAL BREAKS FROM THE CUSUM OF SQUARES TEST

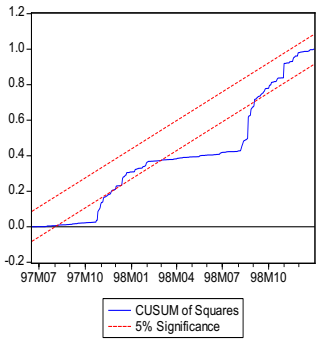
Korean Bond



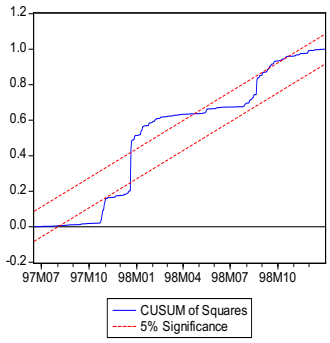
Malaysian Bond



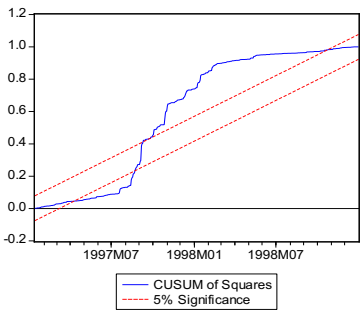
Philippine Bond



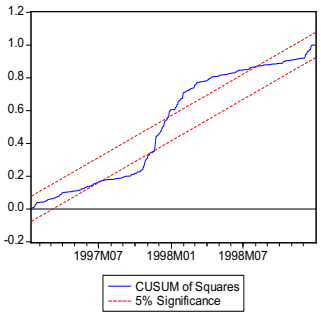
Thai Bond



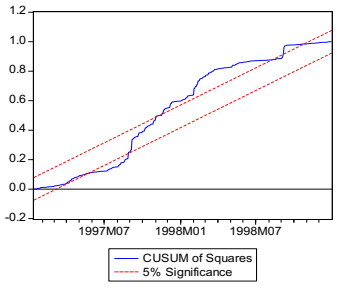
Indonesian Stock



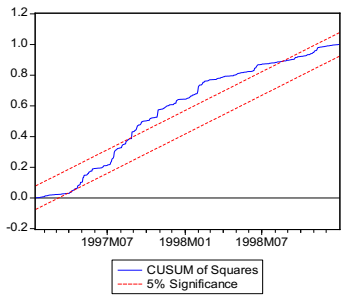
Korean Stock



Malaysian Stock



Philippine Stock



Thai Stock

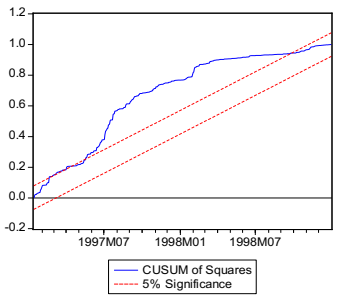


FIGURE 3
EMDB CRISIS FIVE STOCK INDICES (MONTHLY, JANUARY 1990-DECEMBER 2005)

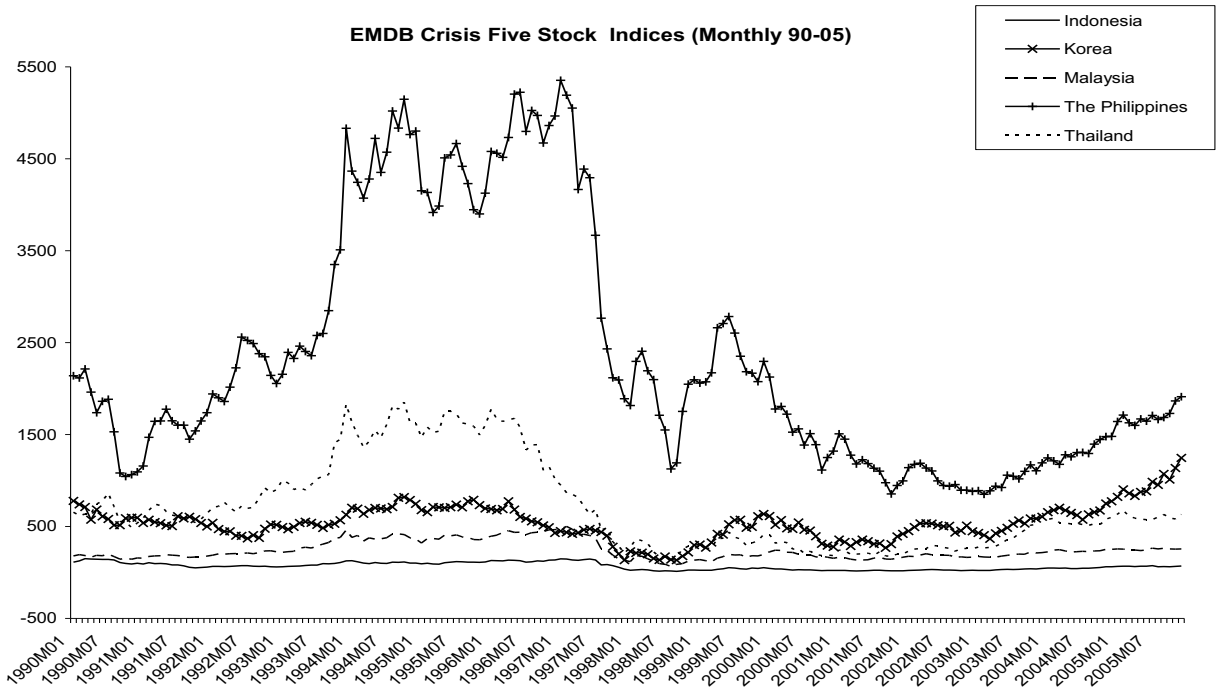
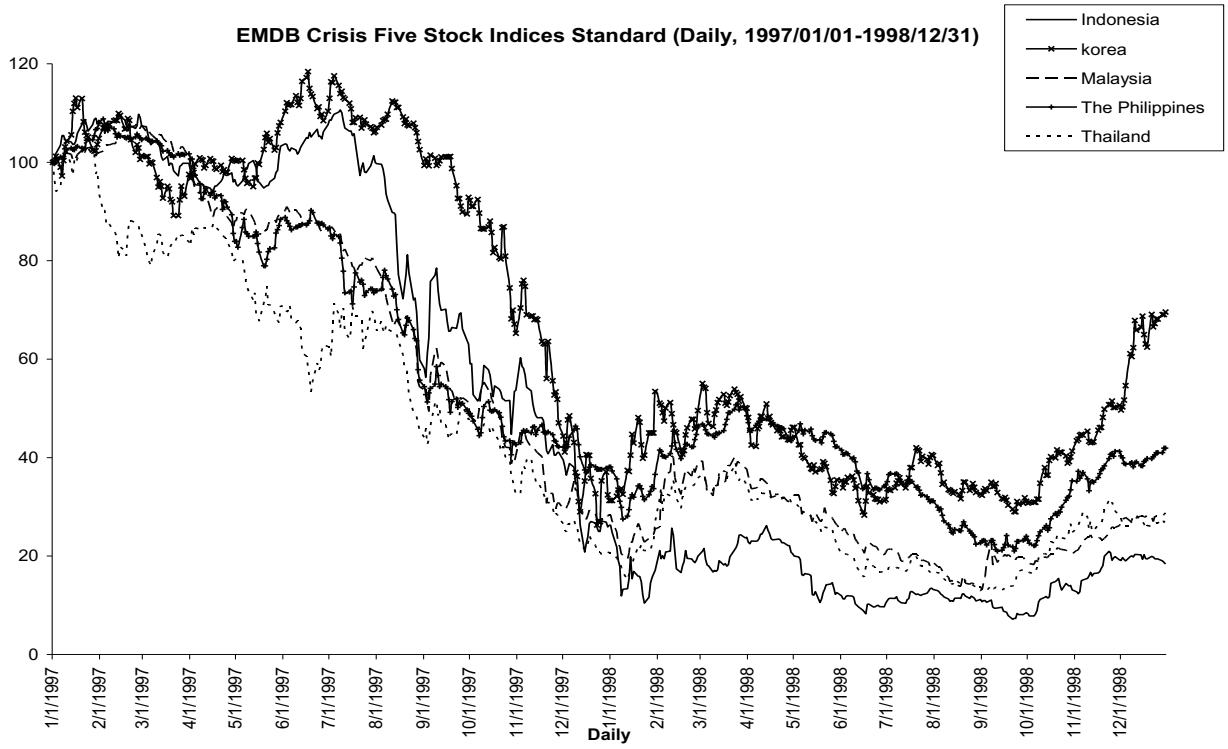


FIGURE 4
EMDB CRISIS FIVE STOCK INDICES STANDARD[2] (DAILY, 1997-1998)



[2] All indices are standardized with 1997/01/01 as 100.

TABLE 1
COMPARISON OF THE CRISIS STOCK INDICES WITH MSCI AC WORLD INDEX

Stock Indices	MSCI AC WORLD	S&P	Indonesia	Korea	Malaysia	The Philippines	Thailand
Average percentage returns (90-05)	0.53%	0.78%	0.61%	0.83%	0.64%	0.34%	0.69%
Standard Deviation (90-05)	4.15%	4.09%	13.28%	12.34%	9.77%	9.66%	12.12%
Average percentage returns (97-98)	-1.86%	2.03%	-4.35%	-0.55%	-3.97%	-2.97%	-3.42%
Standard Deviation (97-98)	7.05%	4.17%	22.95%	17.47%	18.59%	15.46%	22.59%

To the extent that it occurred, blind panic should have been drastic and brief, followed by a quick recovery when the panic was over. A gradual decline lasting for more than twelve months is not consistent with the panic view. A second wave of continuous decline of Asian stocks, starting in January 1998, confirms the further weakening of microeconomic fundamentals. Malaysian and Philippine stocks continued to slide until the end of 1998, which further contradicts the panic theory.

The panic view might explain how a country might get into a crisis without underlying economic weakness. But statistical analysis of the Crisis Five's stocks show that blind panic is not to be blamed for their declines. On the contrary, the long gradual decreases in stocks might just indicate the responsiveness of Asian stock markets to weakening fundamentals and unwise government policies. For example, in August 1997, there was a massive sell-off of Malaysian stocks after the government placed restrictions on short selling of 100 stocks comprising the main benchmark index in the Kuala Lumpur Stock Exchange (KLSE).

Bonds: All crisis countries' bond indices had been increasing steadily, except for two small declines during 1997-1998 (Figure 5). Four indices reached their minimums in August/September of 1998, the same time stocks hit the bottom (Figure 6). Compared with the EMBI global composite, crisis bonds (excepting Malaysian bond) offered higher returns and lower volatilities during 1997-1998. But they were less profitable in the long run (1993-2005) (Table 2).

Bond indices had experienced slight decreases during the two decline periods defined earlier. Except for that of Thai bond, average values of bonds didn't change much during the first decline (Table 3). The drops during the second period were more obvious than those in the first, with percentage decreases for Korean, Malaysian, Philippine, and Thai bonds as 6 percent, 14 percent, 7 percent, and 10 percent respectively. Such changes are small when compared to the significant losses in the currency markets during the same time frame. But Asian bonds historically have low volatilities; and these declines are rather dramatic if compared to Asian bonds' normal range of standard deviations of 3.09 percent, 3.57 percent, 3.48 percent, and 4.42

percent during 1993-2005 (Table 2). Further, while one does not observe panic-like sudden, brief changes in crisis stocks, such a quick decline and recovery behavior can be seen in bond indices. Thus, one cannot eliminate the possibility of a mild panic in Asian bond markets from July to September of 1998 when the Russian crisis took place.

FIGURE 5
EMBI FOUR ASIAN BOND INDICES (MONTHLY, DECEMBER 1993-DECEMBER 2005)

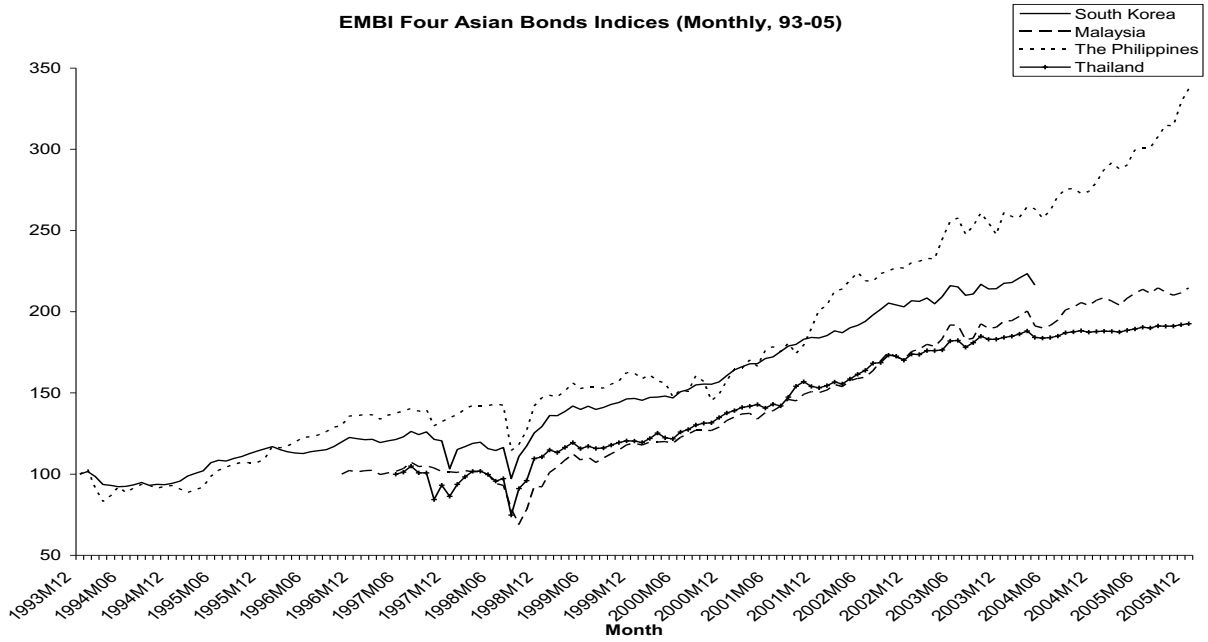


FIGURE 6
EMBI FOUR ASIAN BOND INDICES (DAILY, 1997-1998)

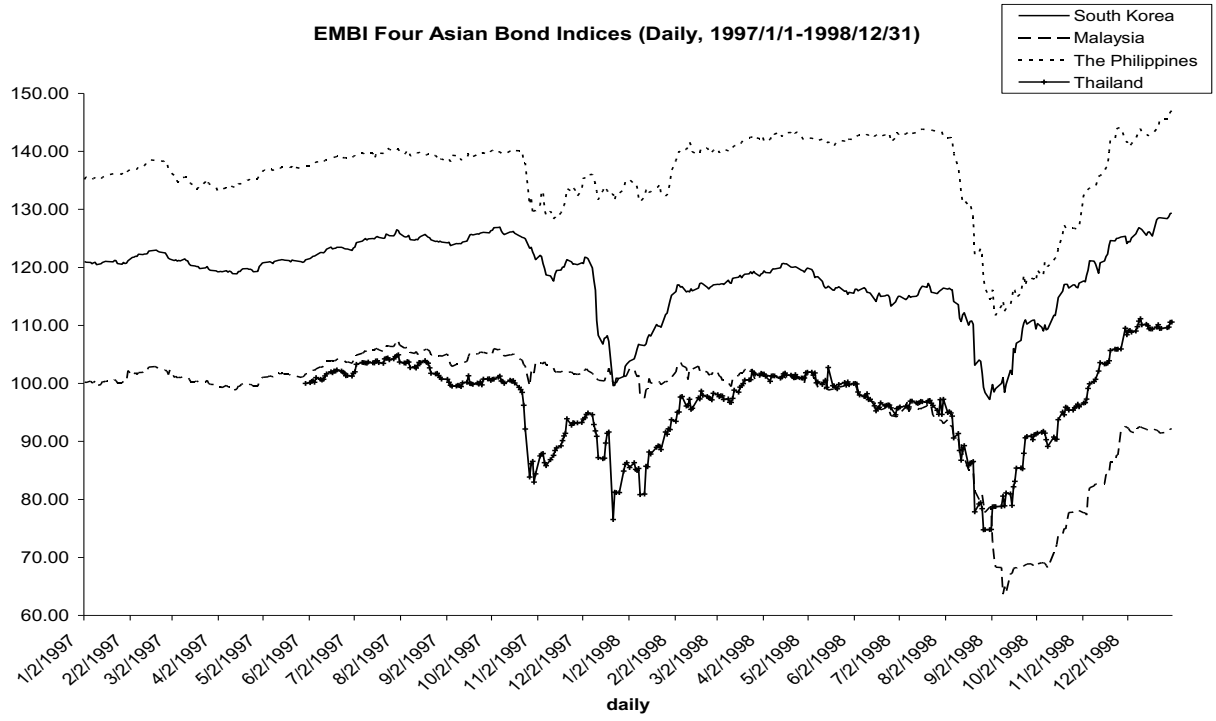


TABLE 2
COMPARISON OF CRISIS BOND INDICES WITH THE GLOBAL COMPOSITE INDEX

Bond Indices	Global Composite	Korea	Malaysia	The Philippines	Thailand
Average percentage returns (93-05)	0.98%	0.67%	0.76%	0.91%	0.74%
Standard Deviation (93-05)	4.43%	3.09%	3.57%	3.48%	4.42%
Average percentage returns (97-98)	-0.01%	0.30%	-0.17%	0.36%	0.65%
Standard Deviation (97-98)	5.28%	4.05%	6.49%	4.62%	5.78%

TABLE 3
AVERAGES OF THE CRISIS BOND INDICES DURING 1997-1998 (DAILY)

	Korea	Malaysia	The Philippines	Thailand
1/2/96-10/2/97 (Before the First Decline)	118.90	102.37	129.71	101.95
10/3/97-1/9/98 (The First Decline)	116.77	102.39	134.13	90.67
1/10/98-7/16/98 (Between Declines)	116.38	99.72	140.94	97.60
7/17/98-9/9/98 (The Second Decline)	109.30	85.59	131.02	87.37
9/10/98-12/31/99 (After the Second Decline)	135.40	102.90	148.65	112.63

The Undifferentiated Risk Perception Theory

If investors had undifferentiated risk perceptions, they should have sold off Asian assets simultaneously during the crisis, which would have caused significant increases of correlation coefficients among assets.

Test results do not show significant changes of stock correlations during 1997-1998. Comparing bond correlations during 1993-2005 vs. 1997-1998, one finds that bond indices were highly correlated over the long run, but not so much during 1997-1998 (Table 4). As an illustration, Malaysia-Korea's correlation decreased from 0.98 (1993-2005) to 0.49 (1997-1998). Malaysia-Thailand's also declined from 0.98 to 0.34. Philippine and Korean bonds had a long-run correlation of 0.98, but it decreased to 0.63 during the crisis. Not only Malaysian bonds had low correlations with others, which could be explained by imposed capital controls, but also all crisis bonds correlations had decreased during 1997-1998. These results indicate that there was no universal increase in risk perceptions among crisis bonds during this time.

These results are different from Baig and Goldfajn (1999)'s. In their study, correlations in sovereign spreads are high. They conclude that "the probability of private debt default was

perceived to have increased dramatically in all of these countries, and nervousness about one market transmitted to other markets readily."

The differences may be due to the different sample periods examined. Baig and Goldfajn employed sovereign spreads of the Crisis Five from 1 July 1997 to 18 May 1998. Such a short time frame does not show high correlations among bonds historically, but only gives the relatively high relationship in isolation. Further, Emerging Market Bond Indices (EMBI) used in this study cover a much broader range of debt instruments than sovereign debt. EMBI provide a better understanding of how the broad credit markets reacted to the crisis.

To compare with Baig and Goldfajn's results, this paper also examined the short-term behavior of bonds during 1997-1998, with special attention paid to the two identified decline periods. Without adjusting for common factors, crisis bonds tend to move together, except during the first decline period. After adjusting for fundamentals and common factors using VAR, bonds had significantly higher residual correlations with each other only during the second decline period (Table 5). For example, residual correlations between Philippine and Korean bonds increased from 0.28 during the first decline to 0.83 during the second. The correlation between Korean and Thai bonds increased from 0.68 to 0.85, and the correlation between Philippine and Thai bonds changed from 0.41 to 0.69. These results indicate that global investors treated crisis bonds individually during the Asian crisis. But when the Russian crisis hit, risk premiums for all Asian bonds increased, suggesting that the widespread increase in risk aversion following the Russian default did affect the Asian financial markets.

TABLE 4
SIMPLE CORRELATION COEFFICIENTS OF THE CRISIS BOND INDICES[3]
(1993-2005 vs. 1997-1998)

	Korea	Malaysia	The Philippines	Thailand
Korea		0.98	0.98	0.99
Malaysia	0.49		0.98	0.98
The Philippines	0.63	0.65		0.95
Thailand	0.83	0.34	0.79	

TABLE 5
VAR RESIDUAL CORRELATION COEFFICIENTS OF THE CRISIS BOND INDICES[4]
(The first vs. the Second Decline Periods)

	Korea	Malaysia	The Philippines	Thailand
Korea		0.25	0.83	0.85
Malaysia	0.34		0.26	0.13
The Philippines	0.28	0.38		0.69
Thailand	0.68	0.65	0.41	

[3] Values in the lower triangle are correlation coefficients during 1997-1998, while values in the upper triangle are during 1993-2005.

[4] Values in the lower triangle are correlation coefficients during the first decline period, while values in the upper triangle are during the second decline.

The Overreaction and Roller Coaster Views

More than ten years have passed since the crisis, and there has been a recovery of the Asian bond markets. The Crisis Five's bonds regained values steadily after 1998.

But conclusions for Asian stocks are less clear. Four out of five stocks still have after-crisis means lower than their during-crisis means. Average returns of three indices in 2005 were lower than their long-run averages (Table 6).

TABLE 6
AVERAGES OF THE CRISIS FIVE'S STOCK INDICES (1990-2005)

Averages	MSCI AC World	Indonesia	Korea	Malaysia	The Philippines	Thailand
90-05	209	68	541	242	2342	705
90-96	140	100	599	293	3128	1117
97-98	236	66	287	226	2738	427
99-05	263	37	554	197	1443	373
2005	289	66	965	253	1705	606

Even with the benefit of hindsight, one cannot clearly determine at this point whether or not Asian stocks experienced a mean reversion. Not only does the data give no clear conclusion, but also much confusion exists in mean reversion studies due to various definitions and testing methodologies. For example, different economic data such as growth rates, stock growth rates, long-run averages, etc., have all been used as benchmarks for mean reversion analyses. Frequently, the long-run averages are used to proxy the long-run equilibrium. But is this a reasonable approximation during a crisis? How long is the long run? Does mean reversion indicate that the crisis has no permanent effects? Are those effects corrective or destructive? There remain many questions about the true meanings of mean reversion. Further research is needed to investigate these issues.

But at least one conclusion can be drawn here. Research on mean reversion agrees that reversions in emerging markets take longer than those in developed nations. It is worth mentioning that it has taken more than ten years for the crisis stocks to return to the mean. This journey is much longer than any other emerging markets had ever taken (Giot, 2003). Such a long recovery times raise serious doubts about the argument that global equity investors had overreacted (Michayluk & Neuhauser, 2006), and that stock prices had taken a roller-coaster ride during the Asian crisis. On the contrary, statistics indicate signs of stock bubbles before the crisis; the crisis might therefore have corrected overheated Asian stock markets.

The Contagion View

If there were contagion among Asian assets during the crisis, one would expect to observe significant increases in correlations only during the decline periods. But test results show that simple correlation coefficients were high among all assets at all time, indicating a high degree of interdependence. After controlling for fundamentals and common factors using VAR, residual correlations were significantly higher only among bonds during bonds' second decline period, suggesting signs of contagion. There was no contagion effect after adjusting for volatility and common factors.

Simple correlations: Long-term simple correlations are calculated using monthly data from 1990 to 2005. In general, stocks had moderate correlations with other stocks before 1997, but

high correlations thereafter, including the after-crisis period from 1999-2005. A bond index had high correlations with other bonds. Those correlations decreased during 1997-1998, but went back up afterward.

Long-term simple correlations show that there is a historically high degree of interdependence among Asian assets. The Crisis Five share similar economic fundamentals and all have significant trade links with Japan and the U.S. Financial distress in one market may cause co-movements in another.

Short-term simple correlations (1997-1998) also indicate that Asian financial assets have a high degree of interdependence. They had been closely correlated both during and outside periods of financial distress. Correlations among stocks had increased during the two decline periods, and remained high after the crisis. Bonds were highly correlated with other bonds in general; this relationship decreased during the first time bonds declined (except for Thai bond), but increased during the second. Correlations remained high thereafter.

There are some interesting discoveries with respect to the relationships of stocks and bonds. The stock and bond indices within the same country were no more closely correlated than their relationship with assets from other countries. This may be due to the fact that Asian stocks are market based, but interest rates are partially controlled by government. Similar to those of bond-bond, stock-stock relationships, stock-bond simple correlations were significantly higher when stocks and bonds declined. Correlations remained high at the end of 1998 when all assets started to recover. One possible explanation is that the appreciation of the Asian currencies and lower interest rates in the U.S caused Asian financial markets to recover. Or it might be that the crisis had simply boosted relationships among different Asian financial assets. In general, stock-bond correlations were higher in 1998 than in 1997.

VAR Residual Correlations: After controlling for fundamentals and common factors using VAR, no significant differences were found in stock-stock residual correlations during decline vs. non-decline periods. Bonds still had higher correlations with other bonds during the second decline, with the exception of the Malaysian bond, which had decreasing relationships with other bonds due to the capital controls imposed. Since there were significant increases in bond residual correlations from 17 July to 9 September 1998, there might be some contagion effects during this time.

Robustness tests using different breakpoints show two intriguing results. First, for both simple and residual correlations, Korean bond and stock indices had decreasing correlations with other four crisis countries' financial assets after 17 October 1997, indicating that the sellout in Korean financial markets was less likely related to what happened in the other crisis four, but more likely caused by other external shocks, such as shocks transmitted from Hong Kong or Taiwan. Second, VAR residual correlations increased significantly among Asian bonds during the Russian crisis, indicating that events in Russia had significant impacts on the Asian bond markets. This coincides with many economists' view that the Russian default in August 1998 had contagious effects on emerging markets (Dungey, Fry, González-Hermosillo & Martin, 2006).

Unconditional Correlation Coefficients: Unconditional correlations during the decline periods are calculated to scale down the upward bias of volatility effect. FR t-statistics show that after adjusting for heteroskedasticity, there were no significant statistical differences among decline vs. non-decline periods correlations. Different breakpoints have been used to test the robustness of these results, and they all confirm Forbes and Rigobon (2002)'s outcome that there was no contagion after adjusting for volatility, but "only interdependence." However, Baig and Goldfajn

(2001) have challenged this volatility adjustment, arguing that higher volatilities were natural parts of a crisis. Clearly further research on the various concepts of contagion and ways of testing them is needed.

CONCLUSIONS

This paper analyzes the Crisis Five's stock and bond country indices during the Asian and Russian crises, and finds that none of the strong views of market behavior considered in this paper fit with the statistics of the crisis countries' stock markets. Responding in part to domestic economic weakening, Asian crisis stocks had been gradually traded down during 1997-1998. The paper also does not find strong support for these hypotheses in the behavior of bonds during the Asian crises. Interestingly, however, it cannot reject the possibility that there might be a mild panic, contagion, or overreaction among crisis bonds when Russia defaulted on its debt in 1998. There were simultaneous increases in risk premia for Asian crisis bonds at this time as well.

One should stress that while the paper found little support for the often asserted views of irrational market behavior investigated here, this does not imply that the markets were fully efficient. There were clearly insufficient exogenous shocks around the time of the Asian crises to justify views that exchange rates were at efficient levels both before and during the crises. It is also interesting to note that there was not the sharp break in the equity markets that there was in the foreign exchange markets. This is clearly due in substantial part to the rather widespread belief before the crises that there was little chance of large depreciations. As a result, a considerable portion of short-term foreign borrowing was unhedged. When the Thai depreciation shattered this assumption, there was a scramble to cover these open positions, which resulted in substantial capital outflows and greater downward pressure on exchange rates. Thus it should not be surprising that the crises had much more dramatic effects in the foreign exchange markets than in the equity and bond markets.

The suspicion is that imperfect market behavior came more in the form of overly optimistic expectations before the crises, rather than overly pessimistic expectations during the crises. Clearly future studies need to move beyond the simple extreme hypotheses that the markets were fully efficient or that they were wildly irrational in the ways tested in this paper (Willett et al. 2004). Between these extremes, there is a rich menu of possible behavior influenced by such factors as imperfect information, principal-agent problems, and considerations identified in the behavioral finance literature such as confirmation bias. These may help us develop a better understanding of the operation of financial markets in developing countries.

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