Can Investor Sentiment be a Channel of Contagion during the 1997 Asian Crisis? Evidence from Closed-End Country Funds

Chu-Sheng Tai
Texas Southern University

This paper tests whether changes in investor sentiment can be a channel of contagion during the 1997 Asian crisis using data from US based closed-end country funds (CECFs) and the corresponding net asset values (NAVs). Specifically, I examine whether there are any incremental conditional mean and asymmetric volatility spillovers between domestic NAV and overseas CECF markets during the crisis after controlling for the shocks from economic fundamentals. The empirical results based on the tests of international CAPM in the absence purchasing power parity with multivariate GARCH-in-mean approach show that before the crisis local NAV investor sentiment is more important than US market sentiment in determining CECF returns, while US market sentiment is more important than CECF investor sentiment in determining NAV returns. During the crisis, the intensity of mean spillover from NAV to CECF has decreased, but it has increased significantly for the mean spillover from CECF to NAV, suggesting that the changes in foreign investor sentiment in particular the sentiment from US CECF investors played the major role in determining local NAV returns and therefore can be the potential cause of the 1997 Asian crisis. After the crisis, both the mean spillovers from NAV to CECF and from CECF to NAV have shifted back to their pre-crisis levels, but the mean spillovers from both US and foreign exchange markets have become more important for CECFs. Finally, there is a unidirectional relationship of asymmetric volatility shocks between CECF and its NAV where the direction of the shocks runs from NAV to CECF, and this relationship strengthens during the crisis. This finding implies that the trading behavior of local NAV investors is the major source of asymmetric volatility shocks to the corresponding CECF traded in the US, and the impact of these shocks increases significantly during the crisis.

INTRODUCTION

The issue of "contagion" has been one of the most debated topics in international finance literature since the 1997 Asian crisis. Two main questions still motivate most of the debate in this topic. First, what are the relevant channels of contagion? Second, how do we measure it? This paper attempts to shed some light on these two questions. Masson (1998) argues that there are three main channels that financial markets turbulence can spread from one country to another. They are monsoonal effects, spillovers and pure contagion effects. 'Monsoonal' effects, or 'contagions from common causes' tend to occur when affected countries have similar economic fundamentals or face common external shocks. The second type of financial market inter-linkages arises from spillover effects, which may be due to trade linkages or financial interdependence.

The first two channels of financial crises can be categorized as fundamentals-driven crises since the affected countries share some macroeconomic fundamentals, which implies that the transmission of financial crises is due to the interdependence among those countries and not necessarily due to contagion. The third transmission channel is the pure contagion effect. Contagion here refers to the cases where crisis in one country triggers a crisis elsewhere for reasons unexplained by macroeconomic fundamentals such as investor sentiments.[1] Frankel and Schmukler (1996, 2000) argue that differing investor sentiment or the existence of asymmetric information in financial markets induces divergent expectations across the local and foreign investor communities, which is reflected in different trading behavior. The impact of this investor heterogeneity may be particularly evident during a financial crisis. Some commentators, including Dornbusch and Park (1995), Radelet and Sachs (1998) and Stiglitz (1998), point out that capital outflows represented a self-fulfilling “rush for the exits” by panicked foreign investors. Indeed, the Prime Minister of Malaysia in well-documented remarks, places the responsibility for the 1997 Asian crisis firmly at the feet of the international investor community, in particular foreign speculative investors. Others claim that the outflows were initiated by massive capital flight by “front-running” local investors.

In this paper, I attempt to addresses this particular issue. Specifically, I test to what extent changes in investor sentiment can be a channel of contagion in the period surrounding the 1997 Asian crisis by examining the direction of information transmission between domestic and overseas markets after controlling for the economic fundamentals shared by both markets. In this study, “information” is defined broadly to include anything that might have a material effect on returns, including changes in investor sentiment. To test whether changes in investor sentiment can be the channel of contagion, I focus on the pricing behavior of five Asian closed-end country funds (CECFs) namely Thailand, Philippines, Indonesia, Malaysia and South Korea, which were seriously affected by the crisis. CECFs provide a useful tool to study contagion and information transmission since two values are available for each fund. CECFs are traded in New York City at their price, while their underlying assets are traded in the equity markets of each respective country at their net asset value (NAV). Even though the CECF is a different way of holding the underlying assets, each fund price is not equal to its NAV. In consequence, I am able to compare the investor demand for basically the same asset in two different parts of the world, and to look separately at how returns in CECFs affect those in NAVs, and vice versa. A finding that returns in CECFs led those in NAVs would thus be evidence for the importance of mature market investor sentiment in determining emerging market returns. A finding that returns in NAVs led those in CECFs, on the other hand, would indicate an important role for local sentiment.

To the best of my knowledge, this is the first study attempting to combine three separate strands of research - contagion, pricing behavior of CECFs, and information transmission in one paper, and therefore it contributes the international finance literature in these three research topics.[2] First, most previous studies on contagion have failed to take into account the important distinction between the two concepts of *interdependence* and *contagion*, and consequently they actually test interdependence instead of the contagion among financial markets. In this paper I define ‘contagion’ as significant spillovers of asset-specific idiosyncratic shocks including the changes in investor sentiment during the crisis after economic fundamentals or systematic risks have been accounted for. In testing for contagion, its existence depends on the economic fundamentals used. Unfortunately, there is disagreement on the definitions of the fundamentals. To control for the economic fundamentals, most empirical studies tend to choose those fundamentals arbitrarily, such as by using macroeconomic variables, dummies for important events, and time trends. The problem with these control variables is that contagion is not well defined without reference to a theory. To overcome this problem, I rely on a theoretical international capital asset pricing model (ICAPM) in the absence of purchasing power parity (PPP) originally developed by Adler and Dumas (1983), which provides me a theoretical basis in selecting the economic fundamentals. The economic fundamentals under ICAPM are the world market and foreign exchange (FX) risks, so the evidence of contagion is based on testing whether idiosyncratic risks - the part that cannot be explained by the world market and FX risk, are significant in describing the dynamic relationship between CECF and NAV returns during the crisis.

Second, empirical studies on the pricing behavior of CECFs mainly focus on the sensitivity of fund returns to US and foreign market returns and do not address what the pricing factors are for CECFs.[3] For example, Chang, Eun, and Kolodny (1995) estimate a model of fund returns with the following two factors: US market returns and the residuals from regressing the appropriate foreign market index return on US market return. They find that the CECFs generally have higher exposure to the domestic market and lower sensitivity to the foreign market than the underlying assets owned by the funds. However, they do not test whether or not these two factors are actually priced. Using mean-variance spanning tests, Bekaert and Urias (1996) show that US CECFs do not provide significant diversification benefits to US investors, but they also fail to answer what the pricing factors are for CECFs. Choi and Lee (1996) test a two-factor model and find that only national factors are priced in CECF returns. However, their asset pricing test is unconditional. In this paper, I test a conditional ICAPM, which allows me to explicitly test whether world market and FX risks are significant in pricing CECF and NAV returns.

Third, prior studies of information transmission or the dynamic relationship between CECF share prices and their NAVs [e.g., Frankel and Schmukler (1996, 1998, 2000), Levy-Yeyati and Ubide (2000), Bowe and Domuta (2001), Lee and Hong (2002)] mainly utilize causality analysis in the context of a VAR/VECM model, which ignores conditional heteroscedasticity found in most financial data. It is important not only to control for the conditional heteroscedasticity in asset returns, but also to model it explicitly since causality analysis allows researchers to examine the information transmission only at price level and not at volatility level. In this paper, I utilize an asymmetric Multivariate General Autoregressive Conditional Heteroscedastic in Mean (MGARCH-M) approach to model conditional means and volatilities of all asset returns including CECFs, NAVs, and two pricing factors. This asymmetric MGARCH-M model allows me not only to capture the time dependencies in the second moments of asset returns, which has been ignored by most empirical studies on contagion[4], but also to address how innovations or shocks generalized by CECFs and NAVs were transmitted during the crisis after controlling for the shocks produced by fundamentals.

The empirical results show that before the crisis local NAV investor sentiment is more important than US market sentiment in determining CECF returns, while US market sentiment is more important than CECF investor sentiment in determining NAV returns. During the crisis, the intensity of mean spillover from NAV to CECF has decreased, but it has increased significantly for the mean spillover from CECF to NAV, suggesting that the changes in foreign investor sentiment in particular the sentiment from US CECF investors played the major role in determining local NAV returns and therefore can be the potential cause of the 1997 Asian crisis. After the crisis, both the mean spillovers from NAV to CECF and from CECF to NAV have shifted back to their pre-crisis levels, but the mean spillovers from both US market and FX have become more important for CECFs. As for the asymmetric volatility spillover, the empirical results show that there is an unidirectional relationship of the asymmetric volatility shocks between CECF and its NAV where the direction of the negative shocks runs from NAV to CECF, and this relationship strengthens during the crisis. This finding implies that the trading behavior of local NAV investors is the major source of asymmetric volatility shocks to the corresponding CECF traded in the US, and the impact of these shocks increases significantly during the crisis.

The remainder of the paper is organized as follows. Section 2 presents the theoretical asset-pricing model used to control for systematic risks when testing pure contagion effects. Section 3 describes the econometric methodology employed to estimate the model and several test hypotheses are presented in Section 4. Section 5 describes the data and empirical results are reported in Section 6. Some conclusions are offered in the final section.

THE CONDITIONAL ICAPM IN THE ABSENCE OF PPP

Based on equations (A11) and (A16) in the Appendix (see Appendix for details of the derivation of ICAPM in the absence of PPP), both equity and FX returns expressed in US dollars can be written as follows.

$$r_{i,t} = \lambda_{m.t-1} \operatorname{cov}_{t-1}(r_{i,t}; r_{m,t}) + \lambda_{c,t-1} \operatorname{cov}_{t-1}(r_{i,t}; r_{c,t}) + \varepsilon_{i,t} \tag{1}$$

$$r_{c,t} = \lambda_{m.t-1} \operatorname{cov}_{t-1}(r_{c,t}; r_{m,t}) + \lambda_{c,t-1} \operatorname{var}_{t-1}(r_{c,t}) + \varepsilon_{c,t} \tag{2}$$

$$r_{m,t} = \lambda_{m.t-1} \operatorname{var}_{t-1}(r_{m,t}) + \lambda_{c,t-1} \operatorname{cov}_{t-1}(r_{m,t}; r_{c,t}) + \varepsilon_{m,t} \tag{3}$$

where $r_{i,t}$ is the excess return of security i ($i = CECF$ or NAV); $r_{c,t}$ is the FX return or the rate of appreciation (or depreciation) of the local currency l versus the US dollar where the exchange rate is expressed in US dollar per unit of local currency; $r_{m,t}$ is the excess return of a world market index.[5] $\lambda_{c,t-1}$ and $\lambda_{m,t-1}$ are the time-varying prices of FX and world market risks, respectively. Finally, $\varepsilon_{i,t}$, $\varepsilon_{c,t}$, and $\varepsilon_{m,t}$ are the error terms associated with $r_{i,t}$, $r_{c,t}$ and $r_{m,t}$, respectively.

ECONOMETRIC METHODOLOGY

The conditional ICAPM in the absence of PPP specified in equations (1)-(3) has to hold for every asset. However, the model does not impose any restrictions on the dynamics of the conditional second moments. Several multivariate GARCH (MGARCH) models have been proposed to model the conditional second moments[6], but the BEKK model of Engle and Kroner (1995) is better suited for the purpose of testing contagion and shock spillovers because it not only guarantees that the covariance matrices in the system are positive definite, but also allows the conditional variances and covariances of different asset markets to influence each other. Therefore, a BEKK structure with asymmetric volatility effects is selected to model the conditional second moments of CECF, NAV, FX, and US market returns and to test contagion and shock spillovers among these returns.[7] Specifically, the dynamic process for the conditional variance-covariance matrix of asset returns is specified as:

$$\begin{aligned} H_t &= C'C + A' \cdot H_{t-1} \cdot A + B' \cdot \varepsilon_{t-1}\varepsilon_{t-1}' \cdot B + D' \cdot \eta_{t-1}\eta_{t-1}' \cdot D \\ &+ G' \cdot \psi_{t-1}\psi_{t-1}' \cdot G + K' \cdot \xi_{t-1}\xi_{t-1}' \cdot K + L' \cdot \mu_{t-1}\mu_{t-1}' L \\ &+ P' \cdot \varsigma_{t-1}\varsigma_{t-1}' \cdot P + Q' \cdot \tau_{t-1}\tau_{t-1}' \cdot Q + S' \cdot \upsilon_{t-1}\upsilon_{t-1}' \cdot S \\ &+ U' \cdot \kappa_{t-1}\kappa_{t-1}' \cdot U + V \cdot \vartheta_{t-1}\vartheta_{t-1}' + W \cdot \pi_{t-1}\pi_{t-1}' W \end{aligned} \tag{4}$$

where H_t is 4×4 time-varying variance-covariance matrix of asset returns; C is restricted to be a 4×4 upper triangular matrix and A, B, D, G, K, L, P, Q, S, U, V, and W are diagonal matrices whose general form, X, is given by:

$$X = \begin{bmatrix} x_{CECF,j} & 0 & 0 & 0 \\ 0 & x_{NAV.j} & 0 & 0 \\ 0 & 0 & x_{FX,j} & 0 \\ 0 & 0 & 0 & x_{US,j} \end{bmatrix} \tag{5}$$

The 4×1 vector, η_{t-1}, captures the asymmetric impact that the vector of past negative innovations has on the conditional covariance matrix in a manner similar to that of Glosten et al. (1993), and is defined as:

$$\eta_{t-1} = \begin{bmatrix} \min(\varepsilon_{CECF,t-1}, 0) \\ \min(\varepsilon_{NAV,t-1}, 0) \\ \min(\varepsilon_{FX,t-1}, 0) \\ \min(\varepsilon_{US,t-1}, 0) \end{bmatrix} \tag{6}$$

Several papers in the literature show that volatility spillovers between markets are asymmetric in the sense that negative innovations in a market increase volatilities in other markets more than do positive innovations in that market. Consequently, the effect of past negative shocks originated from the other three asset markets on the remaining asset market's conditional variance or conditional covariances (asymmetric volatility spillovers) are captured by the vectors ψ_{t-1}, ξ_{t-1}, and μ_{t-1}, which are defined as follows:

$$\psi_{t-1} = \begin{bmatrix} \varepsilon_{NAV,t-1} \\ \varepsilon_{FX,t-1} \\ \varepsilon_{US,t-1} \\ \varepsilon_{CECF,t-1} \end{bmatrix};\ \xi_{t-1} = \begin{bmatrix} \varepsilon_{FX,t-1} \\ \varepsilon_{US,t-1} \\ \varepsilon_{CECF,t-1} \\ \varepsilon_{NAV,t-1} \end{bmatrix};\ \mu_{t-1} = \begin{bmatrix} \varepsilon_{US,t-1} \\ \varepsilon_{CACF,t-1} \\ \varepsilon_{NAV,t-1} \\ \varepsilon_{FX,t-1} \end{bmatrix} \tag{7}$$

To see whether there are any incremental asymmetric volatility spillovers during the *crisis*, vectors ς_{t-1}, τ_{t-1}, and υ_{t-1} are defined as:

$$\varsigma_{t-1} = \begin{bmatrix} crisis[\min(\varepsilon_{NAV,t-1},0)] \\ crisis[\min(\varepsilon_{FX,t-1},0] \\ crisis[\min(\varepsilon_{US,t-1},0)] \\ crisis[\min(\varepsilon_{CECF,t-1},0)]] \end{bmatrix}; \tau_{t-1} = \begin{bmatrix} crisis[\min(\varepsilon_{FX,t-1},0)] \\ crisis[\min(\varepsilon_{US,t-1},0)] \\ crisis[\min(\varepsilon_{CECF,t-1},0)] \\ crisis[\min(\varepsilon_{NAV,t-1},0)]] \end{bmatrix}; \upsilon_{t-1} = \begin{bmatrix} crisis[\min(\varepsilon_{US,t-1},0)] \\ crisis[\min(\varepsilon_{CECF,t-1},0] \\ crisis[\min(\varepsilon_{NAV,t-1},0)] \\ crisis[\min(\varepsilon_{FX,t-1},0)]] \end{bmatrix}; \tag{8}$$

where "$crisis$" is a crisis dummy variable, which is equal to one after 07/04/1997 and zero otherwise.[8] Similarly, to see whether such asymmetric volatility spillovers return to the pre-crisis level, vectors κ_{t-1}, ϑ_{t-1}, and π_{t-1} are specified as:

$$\kappa_{t-1} = \begin{bmatrix} post[\min(\varepsilon_{NAV,t-1},0)] \\ post[\min(\varepsilon_{FX,t-1},0] \\ post[\min(\varepsilon_{US,t-1},0)] \\ post[\min(\varepsilon_{CECF,t-1},0)]] \end{bmatrix}; \vartheta_{t-1} = \begin{bmatrix} post[\min(\varepsilon_{FX,t-1},0)] \\ post[\min(\varepsilon_{US,t-1},0)] \\ post[\min(\varepsilon_{CECF,t-1},0)] \\ post[\min(\varepsilon_{NAV,t-1},0)]] \end{bmatrix}; \pi_{t-1} = \begin{bmatrix} post[\min(\varepsilon_{US,t-1},0)] \\ post[\min(\varepsilon_{CECF,t-1},0] \\ post[\min(\varepsilon_{NAV,t-1},0)] \\ post[\min(\varepsilon_{FX,t-1},0)]] \end{bmatrix}; \tag{9}$$

where "$post$" is a post-crisis dummy variable, which is equal to one after 10/30/1998 and zero otherwise. The difference between the first set of innovation vectors (ψ_{t-1}, ξ_{t-1}, μ_{t-1}) and the second set of innovation vectors (ς_{t-1}, τ_{t-1}, υ_{t-1}) is that the first set captures overall asymmetric volatility spillovers during the *entire* sample period, while the second set captures the incremental asymmetric volatility spillovers during the *crisis* period. By including vectors ς_{t-1}, τ_{t-1}, and υ_{t-1}, I can then test the incremental influences of asymmetric volatility shocks on all asset markets, which is a true test of contagion-in-asymmetric-volatility. In this model, for example, the conditional variance of excess CECF returns, $h_{CECF,t}$, depends on its past conditional variance, $h_{CECF,t-1}$, through the parameter, a_{CECF}, its own past shocks, $\varepsilon_{CECF,t-1}$, through the parameter, b_{CECF}, and its own past negative shocks through the parameter, d_{CECF}. This conditional variance also depends on past negative shocks of the other asset markets through the parameters, g_{CECF}, k_{CECF}, and l_{CECF} in the full sample period, through the parameters, p_{CECF}, q_{CECF}, and s_{CECF} during the crisis period, and through the parameters, u_{CECF}, v_{CECF}, and w_{CECF} in the post-crisis period. Here, these parameters measure the incremental amounts by which bad news in one market at time $t-1$ affect the conditional variance of excess CECF returns at time t.

Even with this diagonal BEKK parameterization, it still requires the estimation of 58 parameters in the conditional covariance matrix.

Under the assumption of conditional normality, the log-likelihood to be maximized can be written as:

$$\ln L(\theta) = -\frac{TN}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T}\ln |H_t(\theta)| - \frac{1}{2}\sum_{t=1}^{T}\varepsilon_t(\theta)' \; H_t(\theta)^{-1}\varepsilon_t(\theta) \tag{10}$$

where θ is the vector of unknown parameters in the model. Since the normality assumption is often violated in financial time series, I use quasi-maximum likelihood estimation (QML) proposed by Bollerslev and Wooldridge (1992) which allows inference in the presence of departures from conditional normality. Under standard regularity conditions, the QML estimator is consistent and asymptotically normal and statistical inferences can be carried out by computing robust Wald statistics. The QML estimates can be obtained by maximizing equation (10), and calculating a robust estimate of the covariance of the parameter estimates using the matrix of second derivatives and the average of the period-by-period outer products of the gradient. Optimization is performed using the Broyden, Fletcher, Goldfarb, and Shanno (BFGS) algorithm.

HYPOTHESIS TESTING

Testing Time-Varying Risk Premium

Many empirical studies have shown that the prices of risks are time-varying. (e.g., Harvey (1991), Dumas and Solnik (1995), and De Santis and Gerard (1997, 1998), among others. This time-varying price of risk is economically appealing in the sense that investors use all available information to form their expectations about future economic performance, and when the information changes over time, they will adjust their expectations and thus their expected risk premia when holding different risky assets. Therefore, to test time-varying risk premium hypothesis, I allow not only the conditional second moments (covariance risks) to change over time, but also the prices of covariance risks to be time-varying.

The dynamics of risk prices are chosen according to the theoretical ICAPM developed by Adler and Dumas (1983). In their model, the price of world market risk is a weighted average of the coefficients of risk aversion of all national investors. Since the weights measure the relative wealth of each country and if all investors are risk averse, the world price of market risk should be positive. Thus, similar to Bekaert and Harvey (1995) and De Santis and Gerard (1997, 1998) an exponential function is used to model the dynamic of $\lambda_{m,t-1}$ and for the dynamic of $\lambda_{c,t-1}$, a linear specification is adopted because the model does not restrict the price of FX risk to be positive.[9]

$$\lambda_{m,t-1} = \exp(\varphi_m' z_{t-1}) \tag{11}$$

$$\lambda_{c,t-1} = \varphi_c' z_{t-1} \tag{12}$$

where Z_{t-1} is a vector of information variables observed at the end of time $t-1$ and φ's are time-invariant vectors of weights. Thus, the price of FX risk is assumed to be a linear function of the information variables in Z_{t-1}, and the price of world market risk is assumed to be an exponential function of information variables in Z_{t-1}. Given the dynamics of the risk prices, I can then test the time-varying risk premium hypothesis by testing whether the information variables in Z_{t-1} are significant in addition to significant GARCH parameters.

Testing Contagion in Mean and Volatility

To test whether an asset's past idiosyncratic shocks have significant impact on the other assets' conditional returns (i.e., contagion-in-mean) during the Asian crisis, I modify the ICAPM specified in equations (1)-(3) by incorporating past asset-specific innovations into the equations. Specifically, equations (1)-(3) can be modified and generalized as:

$$r_{i,t} = \lambda_{m,t-1}\operatorname{cov}_{t-1}(r_{i,t};r_{m,t}) + \lambda_{c,t-1}\operatorname{cov}_{t-1}(r_{i,t};r_{c,t}) + \beta_i\varepsilon_{i,t-1} + \sum_{i\neq j}\phi_{ij}\varepsilon_{j,t-1} + crisis(\sum_{i\neq j}\omega_{ij}\varepsilon_{j,t-1}) + post(\sum_{i\neq j}\delta_{ij}\varepsilon_{j,t-1}) + \varepsilon_{i,t}\,;\forall i,j \qquad (13)$$

In testing the contagion-in-mean effects, I allow own past as well as the other assets' past innovations to affect all asset returns in the *entire* sample period, and then test whether there are any *incremental* influences of an asset's past innovations on the other assets' returns during the *crisis* period. Thus, the contagion-in-mean hypothesis can be examined by testing whether the parameters, $\omega_{ij}(i \neq j)$, are individually or jointly significant after the systematic risks have been accounted for. The inclusion of " $post$ " dummy variable allows me to test whether mean spillovers returned to their pre-crisis levels after the crisis by comparing the size of ($\phi_{ij} + \omega_{ij} + \delta_{ij}$) with that of ϕ_{ij}. If $\phi_{ij} + \omega_{ij} + \delta_{ij}$ is equal to or very close to ϕ_{ij}, it is an indication that the mean spillover from asset j to asset i has returned to its pre-crisis level after the crisis. To test contagion-in-asymmetric-volatility hypothesis, I can test whether the elements in matrices P, Q, and S are individually or jointly significant. For example, a test of null hypothesis that $p_{CECF,j}$ is zero ($H_0 : p_{CECF,j} = 0$) means that there is no contagion in asymmetric volatility shocks from asset j to $CECF$. In addition, I can test whether the negative shocks originating in $CECF$ affect the other three assets by testing the null hypothesis of $H_0 : s_{NAV,j} = q_{FX,j} = p_{US,j} = 0; \forall j = CECF$. Likewise to test whether there is any significant difference of asymmetric volatility spillovers between pre- and post-crisis periods, I can test whether the elements in matrices U, V, and W are individually or jointly significant. Moreover, I can test whether the asymmetric volatility spillovers have returned to their pre-crisis level after the crisis by comparing the size of asymmetric volatility spillover coefficient before the crisis to that of the sum of the asymmetric volatility spillover coefficients before, during, and after the crisis.

DATA AND SUMMERY STATISTICS

In this study, I consider five Asian countries: Indonesia (ID), South Korea (KO), Malaysia (MY), Philippines (PH), and Thailand (TH) that were seriously affected by the 1997 Asian crisis. Friday's weekly closing NAV and the corresponding share price for each of the five Asian CECFs (Indonesia fund, Korea fund, Malaysia fund, First Philippine fund, and Thai fund) traded on New York Stock Exchange were obtained from Bloomberg. As a proxy for US market returns, I use S&P 500 index (US). To obtain excess returns, 7-day Eurodollar interest rate is used as a risk-free asset. The bilateral exchange rate expressed in terms of the US dollar price per unit of foreign currency is used to proxy FX risk (FX) for each country.

To model the dynamics of the prices of US market and FX risks, I select a set of information variables that have been widely used in asset pricing literature (e.g., Harvey (1991), Bekaert and Hodrick (1992), Ferson and Harvey (1993), Bekaert and Harvey (1995), and De Santis and Gerard (1997, 1998), among others). They are excess dividend yield measured by the dividend yield on the S&P 500 index in excess of the 7-day Eurodollar interest rate (DIV), the US default premium, measured by the yield difference between Moody's Baa-rated and Aaa-rated US corporate bonds ($USDP$), the change of Chicago Board Option Exchange's (CBOE) implied volatility index (ΔVIX), which can be used to measure changes in perceived stock market risk or uncertainty and has not yet been used in prior studies as an information variable in testing conditional asset pricing models, the lagged return on the S&P 500 index, and a constant ($CONSTANT$).[10] All the data were extracted from Datastream except the CECF price and NAV data, which were obtained from Bloomberg. The weekly data ranges from 04/06/90 to 06/13/03, which is a 689-data-point series.[11] However, I work with rates of return and use the first difference of the information variables and finally all the information variables are used with a one-week lag, relative to the excess return series; that leaves 687 observations expanding from 04/20/90 to 06/13/03.

Table 1 presents some summary statistics on the weekly returns of CECF and NAV, as well as for the first difference of the log of the bilateral FX rate for each of the five countries under investigation. As can be seen from panel A, the mean returns for CECF, NAV and FX are negative for all five countries, indicating that not only did Asian CECFs and their NAVs perform poorly, but also their currencies were depreciating against the US dollar during the sample period. Among them, ID performs the worst since it has the lowest mean return and the highest standard deviation for its CECF, NAV and FX. The Bera-Jarque test rejects normality of all returns for all countries. Ljung-Box test statistics for raw returns ($LB(20)$) and squared returns ($LB^2(20)$) are significant in all cases except for ID whose $LB(20)$ is not significant, indicating strong linear and nonlinear dependencies in both equity and FX returns. This is consistent with the volatility clustering observed in most financial time-series data, suggesting that the use of a conditional heteroscedasticity model is advisable.

Panel B reports the correlation coefficients for the CECF, NAV and US market returns. It is not difficult to see from the panel that for each country the correlation between CECF and its NAV returns increases significantly during the crisis. For example, the correlation between CECF and NAV returns in the case of ID is 0.486 over the full sample period, but it increases to 0.624 over the crisis period. The same applies to the correlations between CECF and US market returns, and between NAV and US market returns. For instance, the correlations between CECF and US market returns over the full sample and crisis periods in the case of ID are 0.243 and 0.462, respectively. However, it seems that CECF returns are more correlated with its NAV returns than with US market returns over either the full sample period or the crisis period, suggesting the possibility of the dominance of local market sentiment over US market sentiment in determining the CECF returns. This dominance of local market sentiment remains to be tested empirically when the economic fundamentals and their shocks are taken into account.

Finally, the descriptive statistics and correlations for the information variables are shown in Panel C. Most of the correlation coefficients are pretty small, indicating that the selected information variables contain sufficiently orthogonal information.

TABLE 1
DESCRIPTIVE STATISTICS AND CORRELATIONS

The statistics are based on weekly data from 04/20/90 to 06/13/03 (687 observations). The excess returns of Asian closed-end country funds (CECF) are Indonesia (ID^{cecf}), Korea (KO^{cecf}), Malaysia (MY^{cecf}), Philippines (PH^{cecf}), and Thailand (TH^{cecf}). The corresponding returns of their net asset value (NAV) are ID^{nav}, KO^{nav}, MY^{nav}, PH^{nav}, and TH^{nav}, and the changes of bilateral exchange rates expressed in US dollar price per unit of local FX are ID^{fx}, KO^{fx}, MY^{fx}, PH^{fx}, and TH^{fx}. The Bera-Jarque ($B-J$) tests normality based on both skewness and excess kurtosis and is distributed χ^2 with two degrees of freedom. $LB(20)$ and $LB^2(20)$ denote the Ljung-Box test statistics for up to the 20th order autocorrelation of the raw and squared returns, respectively. The information variables are the excess dividend yield, measured by the dividend yield on S&P 500 index in excess of the 7-day Eurodollar deposit rate (DIV), the US default premium, measured by the yield difference between Moody's Baa-rated and Aaa-rated US corporate bonds ($USDP$), the change of CBOE's option implied volatility (ΔVIX), and the lagged excess return of S&P 500 index (US). * and ** denote statistical significance at the 5% and 1% level, respectively.

Panel A: Descriptive statistics (CECF, NAV and FX returns)

	ID^{cecf}	KO^{cecf}	MY^{cecf}	PH^{cecf}	TH^{cecf}
Mean (%)	-0.374	-0.138	-0.275	-0.279	-0.301
Std (%)	7.134	5.661	5.374	4.632	5.966
Min (%)	-42.500	-39.954	-21.122	-17.838	-26.755
Max (%)	30.626	25.292	25.160	26.260	34.917
$B-J$	486.303**	972.078**	445.537**	379.642**	299.039**
$LB(20)$	18.954	32.881*	43.981*	31.456*	31.543*
$LB^2(20)$	107.048**	111.533**	234.255**	67.690**	42.522**
	ID^{nav}	KO^{nav}	MY^{nav}	PH^{nav}	TH^{nav}
Mean (%)	-0.319	-0.086	-0.232	-0.298	-0.276
Std (%)	5.558	5.038	4.308	3.624	4.898
Min (%)	-37.523	-44.287	-29.643	-26.057	-25.238
Max (%)	23.764	24.533	25.909	16.708	18.790
$B-J$	1410.24**	3602.20**	3677.29**	1321.76**	426.926**
$LB(20)$	74.205**	48.699**	60.960**	57.116**	58.761**
$LB^2(20)$	548.066**	111.008**	198.934**	224.525**	474.932**
	ID^{fx}	KO^{fx}	MY^{fx}	PH^{fx}	TH^{fx}
Mean (%)	-0.220	-0.076	-0.048	-0.128	-0.069
Std (%)	4.274	2.564	1.436	1.368	1.670
Min (%)	-57.753	-39.698	-15.256	-10.167	-19.352
Max (%)	35.502	26.797	10.328	6.805	10.680
$B-J$	121788**	409088**	40575**	3861.260**	43849**
$LB(20)$	217.123**	462.235**	152.766**	56.218**	93.590**
$LB^2(20)$	259.174**	356.948**	760.442**	207.889**	112.787**

TABLE 1 (Continued)

Panel B: Correlation (CECF, NAV and FX returns)										
	ID^{cecf}	KO^{cecf}	MY^{cecf}	PH^{cecf}	TH^{cecf}	ID^{nav}	KO^{nav}	MY^{nav}	PH^{nav}	TH^{nav}
Full sample (04/20/1990 – 06/13/2003)										
KO^{cecf}	0.376									
MY^{cecf}	0.376	0.399								
PH^{cecf}	0.329	0.352	0.431							
TH^{cecf}	0.426	0.395	0.488	0.452						
ID^{nav}	0.486	0.344	0.348	0.356	0.316					
KO^{nav}	0.296	0.654	0.287	0.239	0.299	0.323				
MY^{nav}	0.286	0.258	0.478	0.270	0.285	0.410	0.229			
PH^{nav}	0.304	0.330	0.391	0.575	0.371	0.512	0.283	0.424		
TH^{nav}	0.396	0.381	0.491	0.415	0.565	0.473	0.391	0.482	0.468	
US	0.243	0.372	0.373	0.300	0.338	0.185	0.281	0.236	0.236	0.224
Crisis period (07/04/1997 – 10/30/1998)										
KO^{cecf}	0.626									
MY^{cecf}	0.706	0.644								
PH^{cecf}	0.414	0.500	0.537							
TH^{cecf}	0.541	0.486	0.570	0.660						
ID^{nav}	0.624	0.538	0.603	0.489	0.474					
KO^{nav}	0.530	0.747	0.546	0.463	0.461	0.500				
MY^{nav}	0.497	0.312	0.642	0.352	0.338	0.595	0.310			
PH^{nav}	0.458	0.513	0.630	0.663	0.496	0.657	0.413	0.612		
TH^{nav}	0.540	0.506	0.607	0.538	0.565	0.606	0.585	0.588	0.638	
US	0.462	0.433	0.577	0.463	0.314	0.400	0.287	0.401	0.520	0.345

Panel C: conditioning variables				
	DIV	$USDP$	ΔVIX	US
Descriptive Statistics				
Mean (%)	-2.457	0.765	0.006	0.065
Std (%)	1.676	0.212	10.861	2.220
Min (%)	-7.428	0.474	-33.407	-12.397
Max (%)	0.737	1.384	42.801	7.437
correlations				
$USDP$	0.370			
ΔVIX	-0.018	-0.028		
US	-0.016	-0.036	-0.658	

EMPIRICAL EVIDENCE

I estimate the conditional ICAPM with contagion effects (equation (13)) for each country separately utilizing a four-variable asymmetric MGARCH-M approach.[12] The quasi-maximum likelihood estimation of the model is reported in Table 2. The hypothesis tests regarding the prices of market and FX risks and the predictability of information variables are presented in Table 2. The hypothesis tests concerning the total mean and asymmetric volatility spillover effects are shown in Table 4 and Table 5, respectively. Finally, diagnostic test statistics for the standardized residuals are reported in Table 6.

The Evidence of Time-Varying Risk Premia

First, considering the quasi-maximum likehood estimation of the conditional ICAPM reported in Panel A of Table 2 and the test results for the existence of time-varying risk premium reported in Table 3. The results are very encouraging. For example, the null hypothesis of zero prices of US market and FX risks (#1) is strong rejected by Wald statistic with a p-value of zero in all cases. The null hypothesis of constant prices of US market and FX risks (#2) is also strongly rejected at the 1% level in all cases. Next, both the null hypothesis of zero price of US market risk (#3) and the null hypothesis of zero price of FX risk (#5) are rejected at least at the 5% level in all cases. As for the null hypothesis of constant price of US market risk (#4), it is strongly rejected at the 1% level in all cases. For the null hypothesis of constant price of FX risk (#6), it is rejected in three cases (ID , KO , and MY). These test results imply that both US market and FX risks are not only priced but also time varying except for PH and TH whose FX risk is constant. The information variables selected in this paper are very useful in predicting the dynamics of the risk prices as can be seen from the hypothesis tests (#7 - #10). For example, the null hypothesis of

TABLE 2
QUASI-MAXIMUM LIKEHOOD ESTIMATION OF THE CONDITIONAL ICAPM

Panel A: Prices of US market and FX risks, and own return shocks

	ID	KO	MY	PH	TH
	The price of US market risk (φ_m ***)***				
$CONSTANT$	10.029**	7.421**	-76.399*	5.727**	6.979**
DIV	1.184*	1.105**	-48.764*	1.007*	0.770
$USDP$	-123.107**	-72.186**	-23.178	-48.747**	-66.789**
ΔVIX	-1.698	1.104	-160.472*	2.095	0.836
US	-54.333**	-32.235**	-661.879*	-25.772**	-32.397**
	The price of FX risk (φ_c ***)***				
$CONSTANT$	1.030	-15.345	1.247	-5.532	-41.265**
DIV	3.777	-4.865	4.301	-2.551	-17.798*
$USDP$	4.420	131.442	27.865	40.681	253.342*
ΔVIX	17.187**	39.821**	17.840*	-6.306	32.348*
US	-55.720*	79.483	29.739	106.906	360.570*
	Own return shocks				
β_{CECF}	-0.249**	-0.273**	-0.261**	-0.223**	-0.234**
β_{NAV}	0.028	-0.120**	-0.170**	-0.038	-0.006
β_{FX}	-0.088*	-0.079	0.011	-0.070	-0.046
β_{US}	-0.084**	-0.034	-0.073*	-0.051	0.020

zero predictability of DIV (#7) is strongly rejected by the Wald statistic at least at the 5% level in all cases except for ID. As for the null hypothesis of zero predictability of $USDP$ (#8), it is rejected in all cases except for MY. As for the null hypothesis of zero predictability of ΔVIX (#9), it is rejected in all cases except for PH and TH. Finally, for the null hypothesis of zero predictability of US (#10), it is rejected in all cases but ID. Based on these test results, one can safely conclude that both US market and FX risks are significantly in pricing CECF and NAV returns.

TABLE 3
HYPOTHESIS TESTS: PRICES OF RISKS AND PREDICTABILITY OF INFORMATION VARIABLES

Null Hypothesis	ID	KO	MY	PH	TH
1. Are the prices of market and FX risks equal to zero?	599.36	794.032	1071.6	507.19	737.72
$H0: \varphi_{mkt} = \varphi_c = 0; Z_{t-1} = \{CONSTANT, DIV, USDP, \Delta VIX, US\}$	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
2. Are the prices of market and FX risks constant?	64.785	149.701	90.580	116.75	48.862
$H0: \varphi_{mkt} = \varphi_c = 0; Z_{t-1} = \{DIV, USDP, \Delta VIX, US\}$	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
3. Is the price of market risk equal to zero?	383.37	486.377	531.13	475.40	651.98
$H0: \varphi_{mkt} = 0; Z_{t-1} = \{CONSTANT, DIV, USDP, \Delta VIX, US\}$	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
4. Is the price of market risk constant?	13.742	89.626	39.543	28.750	32.004
$H0: \varphi_{mkt} = 0; Z_{t-1} = \{DIV, USDP, \Delta VIX, US\}$	[0.008]	[0.000]	[0.000]	[0.000]	[0.000]
5. Is the price of FX risk equal to zero?	89.939	53.552	12.354	13.343	11.743
$H0: \varphi_c = 0; Z_{t-1} = \{CONSTANT, DIV, USDP, \Delta VIX, US\}$	[0.000]	[0.000]	[0.030]	[0.020]	[0.038]
6. Is the price of FX risk constant?	52.765	52.159	10.907	9.191	8.234
$H0: \varphi_c = 0; Z_{t-1} = \{DIV, USDP, \Delta VIX, US\}$	[0.000]	[0.000]	[0.027]	[0.056]	[0.083]
7. Is there no predictability from excess dividend yield?	4.179	7.801	8.477	12.081	9.013
$H0: \varphi_{mkt,k} = \varphi_{c,k} = 0; \forall k = DIV$	[0.123]	[0.020]	[0.014]	[0.002]	[0.011]
8. Is there no predictability from the change in default premium?	7.534	9.180	2.649	37.319	21.117
$H0: \varphi_{mkt,k} = \varphi_{c,k} = 0; \forall k = USDP$	[0.023]	[0.010]	[0.265]	[0.000]	[0.000]
9. Is there no predictability from the change in option implied volatility?	15.958	16.704	22.652	2.900	5.308
$H0: \varphi_{mkt,k} = \varphi_{c,k} = 0; \forall k = \Delta VIX$	[0.000]	[0.000]	[0.000]	[0.234]	[0.070]
10. Is there no predictability from the US market portfolio?	7.072	12.187	12.817	16.547	20.349
$H0: \varphi_{mkt,k} = \varphi_{c,k} = 0; \forall k = US$	[0.029]	[0.002]	[0.001]	[0.000]	[0.000]

Notes: The first row reports the Wald test statistics and the corresponding p-values are show in the second row.

Evidence of Mean Spillover before, during, and after the Crisis

Mean Spillover before the Crisis

After controlling the systematic US market and FX risks, I can then test the contagion-in-mean effects. However, before that I need to control for the overall mean spillover effects in the entire sample period, so any incremental mean spillover effects can be tested during the crisis period. To find out the sources of mean spillover for each of the four asset markets, one can check statistical significance of individual mean spillover coefficient, $\phi_{i,j}$ ($\forall i \neq j$), reported in Panel B of Table 2. First, considering how CECF returns are affected by return shocks from the other three assets before the crisis, it is obviously that the past return shocks originating in NAV have a stronger impact on the corresponding CECF returns than the shocks generated from FX and US market returns since the coefficient $\phi_{CECF,NAV}$, ranging from 1.42 for TH to 0.428 for PH, is not only statistically significantly positive, but also economically important in all cases. For example, $\phi_{CECF,NAV}$ has a value of 0.428 for PH, implying a 1% unexpected past increase in NAV return will increase current CECF return by 0.346% per week (17.99% annualized). Next, considering how NAV returns are affected by CECF, FX, and US market return shocks, although the past return shocks originating in CECFs have a significant impact on the corresponding NAV returns (four of five cases), it is the FX and US market return shocks that play the major role in determining NAV returns based on the sizes of the coefficients $\phi_{NAV,j}; \forall j = CECF, FX, US$. For instance, in the cases of ID, PH, and TH with significant coefficient of $\phi_{NAV,FX}$, the absolute sizes of their $\phi_{NAV,FX}$ are all greater than those of the corresponding $\phi_{NAV,CECF}$. Similarly, in the cases of ID, MY, and TH with significant coefficient of $\phi_{NAV,US}$, the sizes of $\phi_{NAV,US}$ are also greater than those of the corresponding $\phi_{NAV,CECF}$. This result implies that investor sentiment from the overall US market is more important than the sentiment from CECF investors in explaining NAV returns. Notice that if we compare the size of $\phi_{CECF,NAV}$ with that of $\phi_{NAV,CECF}$, it appears that $\phi_{CECF,NAV}$ dominates $\phi_{NAV,CECF}$ in all cases, indicating that although there is a feedback relation between CECF and NAV returns, the unexpected return shocks from NAV seem to have a stronger impact on its CECF returns. This finding is consistent with Lee and Hong (2002) where they employ a four-variable VAR framework to investigate the relative importance of US market returns, local market returns, and FX returns in determining CECF returns and conclude that CECF returns are more heavily influenced by their local market returns than by US market returns, and the influence from FX is limited.

Turning to the coefficients $\phi_{FX,j}$ ($\forall j = CECF, NAV, US$), $\phi_{FX,NAV}$ is significant in three cases (ID, KO, and TH), but $\phi_{FX,CECF}$ and $\phi_{FX,US}$ are significant in one case only, suggesting the relative importance of the unexpected return shocks emanating from NAV in determining corresponding FX returns. Finally, most of the $\phi_{US,j}$ ($\forall j = CECF, NAV, FX$) are not significant, implying that the return shocks originating in any of the other three assets have no impact on US market returns. The empirical results presented so far based on the statistical significance and the magnitudes of the mean spillover coefficients suggest that before the crisis local NAV investor sentiment is more important than US market sentiment in determining CECF returns, while US market sentiment is more important than CECF investor sentiment in determining NAV returns.

Mean Spillover during the Crisis

Since significant systematic risk premia have been founded and the overall mean spillover effects have been controlled for the entire sample period, I can now test whether there are any incremental mean spillover effects (or contagion-in-mean effects) during the crisis period. As shown in Panel B of Table 2, the coefficient $\omega_{CECF,NAV}$ is statistically significant only for MY ($\omega_{CECF,NAV}$ = 0.274), indicating that there is not much incremental mean spillover effect from NAV to its CECF during the crisis. On the other hand, the coefficient $\omega_{NAV,CECF}$ is significant in four out of five cases, suggesting strong incremental mean spillover effects from CECFs to the corresponding NAVs for theses four countries during the crisis. In addition to comparing the number of significant mean spillover coefficients during the crisis, one can also look at the magnitudes of these coefficients. Panel A of Table 4 reports the total mean spillover effects during the crisis by summing the relevant coefficients. For example, to see whether the mean spillover effect from NAV to CECF decreases or increase during the crisis, one can compare the size of $\phi_{CECF,NAV}$ to that of ($\phi_{CECF,NAV} + \omega_{CECF,NAV}$). From Panel A of Table 4, $\phi_{CECF,NAV} + \omega_{CECF,NAV}$ is less than $\phi_{CECF,NAV}$ in three cases (ID, KO, and PH). As for the size between $\phi_{NAV,CECF}$ and ($\phi_{NAV,CECF}$ + $\omega_{NAV,CECF}$), ($\phi_{NAV,CECF} + \omega_{NAV,CECF}$) is greater than $\phi_{NAV,CECF}$ in all cases except for KO. This implies that the mean spillover effect from NAV to CECF, which is both statistically and economically significant in all cases before the crisis, has decreased during the crisis. However, the mean spillover effect from CECF to NAV, which is less economically important before the crisis, has increased significantly during the crisis. This empirical finding suggests that the changes in foreign investor sentiment in particular the sentiment from US CECF investors played the major role in determining local NAV returns and can be the potential cause of the 1997 Asian crisis. This finding contrasts with that obtained by Frankel and Schmukler (1996) where they conclude that local investors were at the forefront of the 1994 Mexico crisis, but in a later study (Frankel and Schmukler (2000)) they point out that foreign investors may have treated the Pacific Rim differently. However, my finding is consistent with those obtained by Bowe and Domuta (2001) and Cohen and Remolona (2001) where both conclude that the impact of country-specific foreign investor information is enhanced during the Asian crisis, which supports the view that the trading behavior of foreign investors was significant in sustaining the duration of the Asian crisis. Bowe and Domuta (2001) conjecture that the important role assumed by foreign investors during the crisis may reflect the fact that local NAV prices appear to become noisier signals of fundamental value during the crisis, leading investors to place more reliance upon relevant alternatives such as CECF prices.

To see if there are any incremental mean spillover effects attributed to the shocks from FX, the numbers of significant coefficients for $\omega_{CECF,FX}$ and $\omega_{NAV,FX}$ are four and two cases respectively, suggesting that the shocks from FX are responsible for the additional mean spillover effects for CECFs but not for NAVs. This is not surprising since CECFs are traded on US stock exchanges and thus may be influenced by FX changes. However, the FX may have a less direct effect on CECFs due to its offsetting effects. According to Lee and Hong (2002), a currency appreciation may lead to a higher value of a fund when translated into dollars (i.e., translation effect), but it may cause the underlying companies less competitive and may lead to a lower value of the fund (i.e., competitive effect). Since the contagion-in-mean coefficients ($\omega_{CECF,FX}$) are negative in all cases and the bilateral exchange rate is expressed in terms of dollar prices per unit of local currency, it suggests that the competitive effect dominates translation effect, and thus CECF returns decrease as local currency appreciates. As for the incremental shocks from US market, $\omega_{CECF,US}$ is significant only for PH, and $\omega_{NAV,US}$ is significant only for MY, and PH, indicating that the shocks from US market are not as strong as those from CECF and FX.

Turning to how the shocks from CECF, NAV, and US affect FX returns, both $\omega_{FX,CECF}$, and $\omega_{FX,NAV}$ are significant in three cases, and for $\omega_{FX,US}$ it is only significant for PH. This result shows that unexpected return shocks from CECF and NAV are relatively more important than the shocks from US market in determining FX returns. Finally, to see how the shocks from CECF, NAV, and FX affect the US market returns, it is apparently that the shocks from FX are basically responsible for the incremental mean spillover effect for the US market since $\omega_{US,FX}$ is significant in all cases except for ID

Mean Spillover after the Crisis

After the crisis, both the mean spillover effects from NAV to CECF and from CECF to NAV have shifted back to their pre-crisis levels. For example, the total mean spillover effect from NAV to CECF ($\phi_{CECF,NAV} + \omega_{CECF,NAV} + \delta_{CECF,NAV}$) after the crisis is significantly positive in all cases except for MY (see Panel C of Table 4) with an average value of 0.281, which is very close to its pre-crisis level of 0.27. As for the total mean spillover effect from CECF to NAV ($\phi_{NAV,CECF} + \omega_{NAV,CECF} + \delta_{NAV,CECF}$), it is only significant in two cases (MY and PH) with an average value of 0.095, which is also close to its pre-crisis level of 0.075. This result suggests that the important role of NAV on CECF before the crisis resurfaces after the crisis. As for the mean spillover from US market to CECF, it is statistically significant in three cases (ID, KO, and TH), and has become economically more important after the crisis based on the sizes of ($\phi_{CECF,US}+\omega_{CECF,US}+\delta_{CECF,US}$) and $\phi_{CECF,US}$. For example, ($\phi_{CECF,US}+\omega_{CECF,US}+\delta_{CECF,US}$) is greater than $\phi_{CECF,US}$ for each of the three significant cases. As for the mean spillover effect from US market to NAV, it is also significant for ID , KO , and TH , and the effect increases for ID and KO , but decreases for TH . In the case of MY , the mean spillover effect from US market to NAV was significant before the crisis, but has become insignificant after the crisis. As for PH , the effect is insignificant in both periods. As a result, whether the mean spillover effect from the US market to NAV has become more important after the crisis is less conclusive. To see whether there is additional mean spillover coming from FX to CECF, Panel B of Table 4 shows that the effect is significant in three cases (KO , MY , and TH) compared to only one case (PH) before the crisis. In addition, the intensity of the effect is much stronger after the crisis. As for the mean spillover effect from FX to NAV, it is significant for KO and MY , but insignificant for the other three cases. Overall, the empirical results suggest the shocks from both US market and FX have become more important for CECFs in post-crisis period than in pre-crisis period, but the impact of shocks from both US market and FX seems to remain unchanged.

Turning to the shocks from CECF, NAV and US on FX, as can be seen from Panel B of Table 4, most of the means spillover effects are insignificant for all the countries, suggesting that past shocks from CECF, NAV and US market cannot predict current movements of FX. As for the shocks from CECF, NAV and FX on US market, they are significant mostly for FX since the total mean spillover effect from FX to US reported in Panel B of Table 4 is significant in all cases except for TH , suggesting the important role of FX on US market after the crisis.

TABLE 2 (Continued)

Panel B: Mean spillovers before, during and after the crisis

	ID	KO	MY	PH	TH
Pre crisis					
$\phi_{CECF,NAV}$	0.357**	0.224**	0.199**	0.428**	0.142**
$\phi_{CECF,FX}$	0.057	0.244	-0.038	0.589**	0.170
$\phi_{CECF,US}$	0.206	0.236*	0.101	0.169	0.394**
$\phi_{NAV,CECF}$	0.041	0.118**	0.104**	0.067**	0.047*
$\phi_{NAV,FX}$	0.498**	-0.054	0.402	0.170**	-0.762**
$\phi_{NAV,US}$	0.301**	0.093	0.228**	0.039	0.318**
$\phi_{FX,CECF}$	-0.002	-0.005	0.006**	-0.006	-0.003
$\phi_{FX,NAV}$	0.014**	0.012**	-0.001	0.005	0.007*
$\phi_{FX,US}$	-0.008	0.022*	-0.008	0.000	0.009
$\phi_{US,CECF}$	-0.009	0.014	0.011	0.028	-0.001
$\phi_{US,NAV}$	-0.009	-0.011	-0.022	-0.021	-0.039**
$\phi_{US,FX}$	-0.174	-0.009	0.124	-0.017	0.486**
During crisis					
$\omega_{CECF,NAV}$	-0.137	-0.074	0.274**	-0.036	0.032
$\omega_{CECF,FX}$	-0.091	-0.362**	-0.727**	-0.545**	-0.332**
$\omega_{CECF,US}$	-0.639	-0.479	-0.233	-0.979**	-0.419

$\omega_{NAV,CECF}$	0.279**	-0.261**	0.608**	0.132**	0.029
$\omega_{NAV,FX}$	-0.574**	0.124	-0.663	-0.142	0.946**
$\omega_{NAV,US}$	0.109	-0.249	-1.268**	-1.274**	-1.172
$\omega_{FX,CECF}$	-0.134	-0.053**	-0.030**	0.062**	-0.060
$\omega_{FX,NAV}$	0.428**	0.027	-0.021**	0.004	0.096**
$\omega_{FX,US}$	-0.019	0.069	-0.110	-1.003**	-0.314
$\omega_{US,CECF}$	0.000	-0.069*	-0.070	0.091**	0.034
$\omega_{US,NAV}$	0.008	-0.028	0.100*	-0.017	0.041
$\omega_{US,FX}$	0.191	0.224**	-0.148**	0.140*	-0.405**
Post crisis					
$\delta_{CECF,NAV}$	-0.012	0.171**	-0.336**	-0.005	0.178
$\delta_{CECF,FX}$	0.114	-0.963**	30.856*	-0.219	-0.968**
$\delta_{CECF,US}$	1.035*	0.608**	0.273	0.892**	0.441
$\delta_{NAV,CECF}$	-0.353**	0.241**	-0.439**	-0.074	-0.067
$\delta_{NAV,FX}$	0.161	-0.934**	11.216*	0.323	-0.468
$\delta_{NAV,US}$	0.079	0.608**	1.051**	1.286**	1.142
$\delta_{FX,CECF}$	0.148	0.065**	0.024**	-0.073**	0.069**
$\delta_{FX,NAV}$	-0.398**	-0.047*	0.022**	0.023	-0.083**
$\delta_{FX,US}$	0.153	-0.011	0.118*	0.989**	0.309
$\delta_{US,CECF}$	0.002	0.061	0.019	-0.117**	-0.053
$\delta_{US,NAV}$	-0.079*	0.030	-0.090*	0.065	-0.007
$\delta_{US,FX}$	0.172**	-0.617**	5.730*	-0.385**	-0.092

TABLE 4
TOTAL MEAN SPILLOVERS BEFORE, DURING, AND AFTER CRISIS

	ID	*KO*	*MY*	*PH*	*TH*
Panel A: Pre crisis					
1. *NAV* → *CECF*	0.357**	0.224**	0.199**	0.428**	0.142**
2. *FX* → *CECF*	0.057	0.244	-0.038	0.589**	0.170
3. *US* → *CECF*	0.206	0.236*	0.101	0.169	0.394**
4. *CECF* → *NAV*	0.041	0.118**	0.104**	0.067**	0.047*
5. *FX* → *NAV*	0.498**	-0.054	0.402	0.170**	-0.762**
6. *US* → *NAV*	0.301**	0.093	0.228**	0.039	0.318**
7. *CECF* → *FX*	-0.002	-0.005	0.006**	-0.006	-0.003
8. *NAV* → *FX*	0.014**	0.012**	-0.001	0.005	0.007*
9. *US* → *FX*	-0.008	0.022*	-0.008	0.000	0.009
10. *CECF* → *US*	-0.009	0.014	0.011	0.028	-0.001
11. *NAV* → *US*	-0.009	-0.011	-0.022	-0.021	-0.039**
12. *FX* → *US*	-0.174	-0.009	0.124	-0.017	0.486**
Panel B: During crisis					
1. *NAV* → *CECF*	0.219*	0.151*	0.472**	0.392**	0.174**
2. *FX* → *CECF*	-0.035	-0.118	-0.766**	0.043	-0.162
3. *US* → *CECF*	-0.433	-0.243	-0.132	-0.810**	-0.025
4. *CECF* → *NAV*	0.320**	-0.143*	0.712**	0.199**	0.076
5. *FX* → *NAV*	-0.076	0.070	-0.261	0.027	0.184
6. *US* → *NAV*	0.410	-0.157	-1.040**	-1.235**	-0.854
7. *CECF* → *FX*	-0.136	-0.058**	-0.024**	0.056**	-0.063
8. *NAV* → *FX*	0.441**	0.039*	-0.022**	0.008	0.103**
9. *US* → *FX*	-0.028	0.091*	-0.118*	-1.003**	-0.305
10. *CECF* → *US*	-0.009	-0.054	-0.059	0.119**	0.033
11. *NAV* → *US*	-0.001	-0.039	0.078*	-0.038	0.002
12. *FX* → *US*	0.017	0.215**	-0.025	0.123	0.080
Panel C: Post crisis					
1. *NAV* → *CECF*	0.207*	0.322**	0.137	0.387**	0.352**
2. *FX* → *CECF*	0.080	-1.081**	30.090*	-0.176	-1.129**
3. *US* → *CECF*	0.602**	0.365**	0.141	0.082	0.416**
4. *CECF* → *NAV*	-0.032	0.098	0.273**	0.125**	0.009
5. *FX* → *NAV*	0.085	-0.864**	10.955*	0.351	-0.284
6. *US* → *NAV*	0.489**	0.451**	0.011	0.051	0.288**
7. *CECF* → *FX*	0.012	0.007	0.000	-0.017	0.006
8. *NAV* → *FX*	0.044	-0.007	0.000	0.032	0.020
9. *US* → *FX*	0.126**	0.080**	0.000	-0.014	0.004
10. *CECF* → *US*	-0.007	0.007	-0.040	0.002*	-0.020
11. *NAV* → *US*	-0.080**	-0.008	-0.012	0.027	-0.005
12. *FX* → *US*	0.189**	-0.402**	5.706*	-0.262*	-0.012

Evidence of Asymmetric Volatility Spillover before, during, and after Crisis

I now turn to the asymmetric volatility spillover effects in different periods. Panel D of Table 2 reports the estimates of the individual asymmetric volatility spillover coefficients before, during and after the crisis. As can be seen from Panel D, the asymmetric volatility spillover coefficient is only significant in six cases in total for all countries: three of them are from NAV to CECF (KO, MY, and TH), two of them are from CECF to US market (KO, MY), and the other one is from FX to NAV (MY), suggesting that most of the asymmetric volatility spillovers originate from NAV to CECF before the crisis. During the crisis, the incremental asymmetric volatility spillover coefficients are significant in 21 cases, and they are economically important based on their sizes. Most of the incremental spillover effects are from NAV to CECF (in all cases but KO) and from CECF to US market (in all cases but KO), indicating that the asymmetric volatility spillovers from both NAV to CECF and CECF to US market intensify during the crisis. These results imply that during the crisis past negative return shocks from local NAV predict a higher volatility for current CECF returns, while the negative return shocks from CECF imply a higher volatility for current US market returns. In addition, the incremental asymmetric volatility spillover coefficient from FX to NAV has increased from just one case before the crisis to three cases during the crisis, suggesting that an unexpected depreciation in local currency predicts a higher volatility for NAV returns. After the crisis, it does not seem to have much incremental asymmetric volatility spillover effect since the incremental asymmetric volatility spillover coefficient is significant in only 5 cases for all countries, suggesting that the intensity of asymmetric volatility spillovers has dropped in post-crisis period compared to the crisis period. Although there is a decrease in the asymmetric volatility spillover effect after the crisis, it is still significant in 12 cases compared with only 6 cases before the crisis for all countries as can be seen from Table 5 which reports the total asymmetric volatility effects before, during, and after the crisis.[13] To summarize, the major finding regarding asymmetric volatility spillover in this section indicates that there seems to have a strong unidirectional relationship of the asymmetric volatility shocks between CECF and its NAV where the direction of the negative shocks runs from NAV to CECF, and this relationship strengthens during the crisis. This finding implies that the trading behavior of local NAV investors is the major source of asymmetric volatility shocks to the corresponding CECF traded in the US, and the impact of these shocks increases significantly during the crisis.

TABLE 2 (Continued)

Panel C: Conditional variance and own asymmetric volatility shocks

	ID	KO	MY	PH	TH
a_{CECF}	0.961**	0.973**	0.982**	0.955**	0.977**
a_{NAV}	0.946**	0.962**	0.935**	0.937**	0.951**
a_{FX}	0.937**	0.891**	0.713**	0.893**	0.769**
a_{US}	0.989**	0.986**	0.978**	0.989**	0.987**
b_{CECF}	0.229**	0.192**	0.132**	0.165**	0.088**
b_{NAV}	0.211**	0.218**	0.051*	0.244**	0.197**
b_{FX}	0.197**	0.424**	1.120**	0.564**	0.620**
b_{US}	-0.083*	0.145**	0.145**	0.074**	0.129**
d_{CECF}	0.233	0.101	0.098	0.925	1.036*
d_{NAV}	2.060**	-0.042	0.111	0.182	0.769*
d_{FX}	3.803**	0.222	0.805	-0.038	1.573
d_{US}	0.308	0.090	0.080	0.938*	0.440

TABLE 2 (Continued)

Panel D: Asymmetric volatility spillovers before, during, and after the crisis

	ID	*KO*	*MY*	*PH*	*TH*
Pre crisis					
$g_{CECF,NAV}$	0.000	0.619*	0.902**	0.009	0.697*
$k_{CECF,FX}$	0.424	0.001	0.257	2.437	-0.164
$l_{CECF,US}$	1.049	-0.246	0.031	0.008	0.014
$l_{NAV,CECF}$	0.184	-0.258	0.138	0.030	0.003
$g_{NAV,FX}$	-0.005	0.598	16.571**	-0.001	1.498
$k_{NAV,US}$	0.083	0.000	-0.016	-0.003	0.219
$k_{FX,CECF}$	-0.001	0.000	0.002	-0.002	0.104
$l_{FX,NAV}$	0.554	-0.008	0.010	0.000	0.001
$g_{FX,US}$	-0.004	0.086	0.000	0.000	0.191
$g_{US,CECF}$	0.000	0.130**	0.152**	0.000	0.067
$k_{US,NAV}$	0.075	0.000	0.049	-0.031	-0.058
$l_{US,FX}$	-0.020	0.066	-0.005	0.003	0.028
During crisis					
$p_{CECF,NAV}$	1.112**	-0.002	0.639*	1.461**	-1.136**
$q_{CECF,FX}$	0.650	0.000	0.184	2.713	-0.002
$s_{CECF,US}$	-2.813	0.675*	0.061	-0.247	1.173
$s_{NAV,CECF}$	-0.622**	0.552*	0.242	-0.690	0.213
$p_{NAV,FX}$	1.628**	0.008	6.047	11.841**	-3.324**
$q_{NAV,US}$	1.111	-0.001	0.066	1.049*	-0.001
$q_{FX,CECF}$	0.048	0.000	-0.003	1.255**	-0.001
$s_{FX,NAV}$	-1.436**	0.624**	-0.006	-0.135	0.491
$p_{FX,US}$	-0.219	-0.003	0.000	0.490	-2.447*
$p_{US,CECF}$	0.134**	-0.006	0.336**	0.556**	-0.324**
$q_{US,NAV}$	0.112*	0.000	0.047	-0.080	0.000
$s_{US,FX}$	0.015	0.142	0.000	-0.823	0.501*
Post crisis					
$u_{CECF,NAV}$	0.215	0.001	0.004	-0.623	-1.123
$v_{CECF,FX}$	-1.863	-0.262	-267.595	-16.857**	0.001
$w_{CECF,US}$	0.073	-0.040	-0.379	-0.027	0.003
$w_{NAV,CECF}$	-0.016	0.000	-1.669*	-0.060	0.001

$u_{NAV,FX}$	0.409	-0.005	-559.903	-8.657	-4.391
$v_{NAV,US}$	0.872	0.018	-0.101	0.015	-0.001
$v_{FX,CECF}$	0.045	-0.026	0.005	-0.012	-0.001
$w_{FX,NAV}$	-0.105	-0.057	-0.003	-0.022	0.000
$u_{FX,US}$	1.348*	0.000	0.000	-0.371	-1.527
$u_{US,CECF}$	0.003	0.001	0.004	-0.927*	-0.231
$v_{US,NAV}$	-0.417	-0.107	-0.038	-0.642	-0.001
$w_{US,FX}$	0.901	-6.567	- 128080**	-2.280	-0.008

TABLE 5
TOTAL ASYMMETRIC VOLATILITY SPILLOVERS BEFORE, DURING, AND AFTER CRISIS

	ID	*KO*	*MY*	*PH*	*TH*
Panel A: Pre crisis					
1. $NAV \rightarrow CECF$	0.000	0.383*	0.814*	0.000	0.486*
2. $FX \rightarrow CECF$	0.180	0.000	0.066	5.940	0.027
3. $US \rightarrow CECF$	1.101	0.060	0.001	0.000	0.000
4. $CECF \rightarrow NAV$	0.034	0.067	0.019	0.001	0.000
5. $FX \rightarrow NAV$	0.000	0.358	274.585**	0.000	2.243
6. $US \rightarrow NAV$	0.007	0.000	0.000	0.000	0.048
7. $CECF \rightarrow FX$	0.000	0.000	0.000	0.000	0.011
8. $NAV \rightarrow FX$	0.307	0.000	0.000	0.000	0.000
9. $US \rightarrow FX$	0.000	0.007	0.000	0.000	0.037
10. $CECF \rightarrow US$	0.000	0.017**	0.023**	0.000	0.005
11. $NAV \rightarrow US$	0.006	0.000	0.002	0.001	0.003
12. $FX \rightarrow US$	0.000	0.004	0.000	0.000	0.001
Panel B: During crisis					
1. $NAV \rightarrow CECF$	1.237**	0.383**	1.222**	2.135*	1.777
2. $FX \rightarrow CECF$	0.603	0.000	0.100	13.302	0.027
3. $US \rightarrow CECF$	9.014	0.516	0.005	0.061	1.377
4. $CECF \rightarrow NAV$	0.420**	0.372	0.077	0.477	0.046
5. $FX \rightarrow NAV$	2.649**	0.358	311.151**	140.2**	13.291
6. $US \rightarrow NAV$	1.241	0.000	0.005	1.101*	0.048
7. $CECF \rightarrow FX$	0.002	0.000	0.000	1.575**	0.011
8. $NAV \rightarrow FX$	2.368	0.389**	0.000	0.018	0.241
9. $US \rightarrow FX$	0.048	0.007	0.000	0.240	6.026*
10. $CECF \rightarrow US$	0.018*	0.017	0.136**	0.309**	0.109*
11. $NAV \rightarrow US$	0.018	0.000	0.005	0.007	0.003
12. $FX \rightarrow US$	0.001	0.024	0.000	0.677	0.251

Panel C: Post crisis					
1. $NAV \rightarrow CECF$	1.283*	0.383	1.222**	2.522	3.039
2. $FX \rightarrow CECF$	4.074	0.068	7.16E+04	297.467	0.027
3. $US \rightarrow CECF$	9.019	0.517	0.149	0.062	1.377
4. $CECF \rightarrow NAV$	0.420*	0.372	2.863	0.481	0.046
5. $FX \rightarrow NAV$	2.816*	0.358	3.14E+05	215.146	32.572
6. $US \rightarrow NAV$	2.001	0.000	0.015	1.102*	0.048
7. $CECF \rightarrow FX$	0.004	0.001	0.000	1.575**	0.011
8. $NAV \rightarrow FX$	2.379	0.393**	0.000	0.019	0.241
9. $US \rightarrow FX$	1.865	0.007	0.000	0.377	8.358**
10. $CECF \rightarrow US$	0.018*	0.017	0.136**	1.168	0.162**
11. $NAV \rightarrow US$	0.192	0.011	0.006	0.419	0.003
12. $FX \rightarrow US$	0.812	43.153	1.64E+10**	5.878	0.251

Notes: The total asymmetric volatility spillover effects before, during, and after the crisis reported in this table are computed first by squaring the estimated individual asymmetric volatility spillover coefficients reported in Panel D of Table 3. The squared asymmetric volatility spillover coefficient before the crisis is then added to the corresponding squared asymmetric volatility spillover coefficient during the crisis to obtain the total asymmetric volatility spillover effect *during* the crisis. To obtain the total asymmetric volatility spillover effect *after* the crisis, the corresponding squared asymmetric volatility coefficient after the crisis is then added to the total asymmetric volatility spillover effect during the crisis calculated previously.

Residual Diagnostics

To access the fit of the conditional ICAPM in the absence of PPP with MGARCH-M(1,1) specification, Panel A and B of Table 6 reports the Ljung-Box statistics for 20th-order serial correlation in the level ($LB(20)$) and squared standardized residuals ($LB^2(20)$) as well as the asymmetry test developed by Engle and Ng (1993). Under the multivariate framework, the standardized residuals at time t is computed as $Z_t = H_t^{-1/2}\varepsilon_t$, where $H_t^{-1/2}$ is the inverse of the Cholesky factor of the estimated variance-covariance matrix. All the $LB(20)$ and $LB^2(20)$ statistics are significant lower than the corresponding statistics found in the raw returns and most of them are insignificant, indicating that the GARCH process has reduced or eliminated all the linear and nonlinear dependencies shown in the raw returns. However, as suggested by Engle and Ng, the Ljung-Box test may not have much power in detecting misspecifications related to the asymmetric effects. For this purpose, the set of diagnostics proposed by Engle and Ng (1993) are used.[14] These tests are based on the news impact curve implied by a particular ARCH-type model used. The premise is that if the volatility process is correctly specified, then the squared standardized residuals should not be predictable based on observed variables. The results reported in Panel B of Table 6 show no strong evidence of misspecification. As for $B-J$ test statistics, they are still significant, indicating departures from the normality, which justifies the use of robust standard errors computed from using the quasi-maximum likelihood method of Bollerslev and Wooldridge (1992). Overall the MGARCH(1,1)-M specification fits the data very well.

TABLE 6
RESIDUAL DIAGNOSTICS

Panel A: Ljung-Box test statistics

	CECF	*NAV*	*FX*	*US*
ID				
$B-J$	136.743**	18.345**	260.964**	12.388**
$LB(20)$	9.957	39.134**	28.486	27.238
$LB^2(20)$	37.578**	11.792	25.696	24.033
KO				
$B-J$	440.218**	99.543**	1942.90**	12.132**
$LB(20)$	15.781	20.503	26.444	36.471*
$LB^2(20)$	14.877	31.282	18.248	14.914
MY				
$B-J$	224.434**	670.531**	7276.07**	51.269**
$LB(20)$	27.670	24.426	31.273	26.886
$LB^2(20)$	51.331**	12.129	33.506*	15.278
PH				
$B-J$	47.280**	205.685**	8195.69**	32.053**
$LB(20)$	22.408	22.042	38.074**	24.546
$LB^2(20)$	25.159	28.851	6.040	30.925
TH				
$B-J$	173.880**	17.305**	142.030**	21.495**
$LB(20)$	24.865	23.065	18.038	27.982
$LB^2(20)$	11.801	15.246	7.929	11.142

Notes: The Bera-Jarque ($B-J$) tests normality based on both skewness and excess kurtosis and is distributed χ^2 with two degrees of freedom. $LB(20)$ and $LB^2(20)$ are the Ljung-Box test statistics of order 20 for serial correlation in the standardized residuals and standardized residuals squared. * and ** denote statistical significance at the 5% and 1% level, respectively.

TABLE 6 (Continued)

Panel B: Engle and Ng (1993) asymmetric tests				
	CECF	*NAV*	*FX*	*US*
ID				
Sign bias test	-1.849	-0.841	0.179	0.903
Negative size bias test	-1.373	-0.172	-0.329	-0.294
Positive size bias test	1.161	-1.347	0.055	-0.057
Joint test	3.249*	0.655	0.056	0.887
KO				
Sign bias test	0.110	1.101	1.258	0.922
Negative size bias test	-0.764	-0.085	-0.018	-0.659
Positive size bias test	0.440	0.270	-0.296	-0.042
Joint test	0.301	0.517	0.732	1.154
MY				
Sign bias test	-0.937	-0.751	2.443*	-0.978
Negative size bias test	-1.998*	0.095	0.709	-0.594
Positive size bias test	0.734	-1.132	0.264	-1.886
Joint test	1.586	0.476	2.002	1.340
PH				
Sign bias test	0.395	0.743	0.199	0.245
Negative size bias test	0.612	0.978	0.385	-0.510
Positive size bias test	0.180	-1.072	-0.229	-0.198
Joint test	0.136	0.949	0.075	0.342
TH				
Sign bias test	0.195	-1.050	-1.064	1.408
Negative size bias test	-0.010	-1.280	-0.214	-0.536
Positive size bias test	0.278	-1.939	0.162	0.518
Joint test	0.028	1.826	0.465	1.318

Notes: Engle and Ng (1993) asymmetric tests include the sign bias, the negative size bias, and the positive size bias tests. The sign bias test examines the impact of positive and negative innovations on volatility not predicted by the model. The squared standardized residuals are regressed against a constant and a dummy S_t^- that takes the value of unity if ε_{t-1} is negative, and zero otherwise. The test is based on the t statistic for S_t^-. The negative (positive) size bias test examines how well the model captures the impact of large and small negative (positive) innovations, and it is based on the regression of the squared standardized residuals against a constant and $S_t^- \varepsilon_{t-1}$ $((1 - S_t^-)\varepsilon_{t-1})$. The computed t statistic for $S_t^- \varepsilon_{t-1}$ $((1 - S_t^-)\varepsilon_{t-1})$ is used in this test.

SUMMARY AND CONCLUDING REMARKS

This paper tests whether changes in investor investment can be a channel of contagion during the 1997 Asian crisis using data from US based CECFS and their NAVs. Specifically, I examine whether there are any incremental conditional mean and volatility spillovers between domestic NAV and overseas CECF markets during the crisis after controlling for the shocks from economic fundamentals. The empirical results based on the tests of ICAPM in the absence PPP with MGARCH-M approach show that before the crisis local NAV investor sentiment is more important than US market sentiment in determining CECF returns, while US market sentiment is more important than CECF investor sentiment in determining NAV returns. During the crisis, the intensity of mean spillover from NAV to CECF has decreased, but it has increased significantly for the mean spillover from CECF to NAV, suggesting that the changes in foreign investor sentiment in particular the sentiment from US CECF investors played the major role in determining local NAV returns and therefore can be the potential cause of the 1997 Asian crisis. This finding is consistent with those obtained by Bowe and Domuta (2001) and Cohen and Remolona (2001) where both conclude that the impact of country-specific foreign investor information is enhanced during the Asian crisis, which supports the view that the trading behavior of foreign investors was significant in sustaining the duration of the Asian crisis. After the crisis, both the mean spillovers from NAV to CECF and from CECF to NAV have shifted back to their pre-crisis levels, but the mean spillovers from both US and FX markets have become more important for CECFs. Regarding the asymmetric volatility spillover, the empirical results show that there is a unidirectional relationship of the asymmetric volatility shocks between CECF and its NAV where the direction of the negative shocks runs from NAV to CECF, and this relationship strengthens during the crisis. This finding implies that the trading behavior of local NAV investors is the major source of asymmetric volatility shocks to the corresponding CECF traded in the US, and the impact of these shocks increases significantly during the crisis.

APPENDIX

In deriving the nominal ICAPM of Adler and Dumas (1983), we begin with the classic CAPM of Sharpe (1964), Lintner (1965) and Mossin (1966). The classic CAPM says that, in equilibrium, there must exist two numbers, η and θ, such that, for all securities i [15]:

$$E(\rho_i) = \eta + \theta \operatorname{cov}(\rho_i ; \rho_m) \tag{A1}$$

where ρ_i is the real rate of return on security i.

ρ_m is the real rate of return on the domestic market portfolio.

η is the real rate of return on a zero-beta portfolio.

θ is the market average degree of risk aversion.

Since the real rate of return is unobservable, we have to transform it into a nominal rate of return. The real rate of return, ρ_i, is given by:

$$\rho_i = \frac{1+R_i}{1+\pi} - 1 \tag{A2}$$

where R_i is the nominal rate of return.

π is the rate of inflation.

Suppose both the security price and general price index follow stationary Ito processes (i.e., geometric Brownian motion):

$$R_i dt = \frac{dP_i}{p_i} = E(R_i)dt + \sigma_i dw_i \tag{A3}$$

$$\pi_i dt = \frac{dI_i}{I_i} = E(\pi_i)dt + \sigma_\pi dz_\pi \tag{A4}$$

where p_i is the price of security i ;

$E(R_i)$ is the instantaneous nominal expected rate of return on security i ;

σ_i is the instantaneous standard deviation of the nominal return on security i ;

w_i is a standard Wiener process and dw_i is the associated white noise;

I_i is the general price index;

$E(\pi_i)$ is the expected value of the instantaneous rate of inflation;

σ_π is the standard deviation of the instantaneous rate of inflation;

z_π is a standard Wiener process and dz_π is the associated white noise.

We can substitute equations (A2), (A3) and (A4) into equation (A1) and apply Ito's lemma to obtain:

$$E(R_i) - E(\pi) + \text{var}(\pi) - \text{cov}(R_i, \pi) = \eta + \theta \,\text{cov}(R_i - \pi; R_m - \pi) \qquad \text{(A5)}$$

Expanding the $\text{cov}(R_i - \pi; R_m - \pi)$, and rearranging terms:

$$E(R_i) = \eta + E(\pi) - (1-\theta)\,\text{var}(\pi) - \theta\,\text{cov}(R_m;\pi) + (1-\theta)\,\text{cov}(R_i;\pi) + \theta\,\text{cov}(R_i;R_m) \qquad \text{(A6)}$$

In equation (A6), the first four terms of the right-hand side sum to nominally risk-free rate of return, R, if it exists. Thus, we can rewrite equation (A6) in the following form:

$$E(R_i) = R + (1-\theta)\,\text{cov}(R_i;\pi) + \theta\,\text{cov}(R_i;R_m) \qquad \text{(A7)}$$

Equation (A7) is a nominal CAPM which indicates that uncertain inflation produces a separate premium in nominal term even if investors were risk neutral (θ = 0).

Next we want to extend this nominal CAPM in an international setting. We can measure the rate of inflation over a period in any country in any currency. Suppose we choose the US dollar ($) as numeraire, then the rate of inflation in country l in terms of $ can be expressed as following:

$$\pi_l^\$ = (1+\pi_l^l)(1+e_l^\$) - 1 \qquad \text{(A8)}$$

where $\pi_l^\$$ is the rate of inflation in country l in dollar units;

$e_l^\$$ is the relative change in the spot exchange rate (dollar price of one unit local currency) over the period.

Similarly, the rate of return, R_i, of all securities expressed in foreign currency units can be translated into dollar using following formula:

$$R_i^\$ = (1+R_i^l)(1+e_l^\$) - 1 \qquad \text{(A9)}$$

where R_i^l is the rate of return on security i expressed in the non-dollar currency ;

$e_l^\$$ is the rate of change of the spot exchange rate expressed in dollars per unit of non-dollar currency.

The nominal ICAPM, expressed in dollars, can now be derived in the following way. For each country l, a domestic nominal CAPM similar to equation (A7) holds:

$$E(R_i^\$) = R + (1-\theta^l)\,\text{cov}(R_i^\$;\pi_l^\$) + \theta^l\,\text{cov}(R_i^\$;R_m^\$) \qquad \text{(A10)}$$

where R is the dollar, nominally risk-free interest rate;

$R_m^\$$ is the dollar rate of return on the optimal portfolio held by the investors of country l.

Since the variability in the exchange rate is much greater than the variability in the inflation rate, we can assume that local inflation rate is nonrandom, which is the case of Solnik (1974), then $\text{cov}(R_i^\$;\pi_l^\$) = \text{cov}(R_i^\$;e_l^\$)$ because $\pi_l^l + e_l^\$ = \pi_l^\$$.[16] Therefore, equation (A10) can be written as:

$$E(R_i^\$) = R + (1-\theta^l)\operatorname{cov}(R_i^\$; e_l^\$) + \theta^l \operatorname{cov}(R_i^\$; R_m^\$) \qquad \text{(A11)}$$

Consequently, the foreign exchange risk becomes one of the systematic risks in equation (A11) under which PPP does not hold and local inflation rates are nonstochastic.

If financial market is integrated, then equation (A11) can be applied to price all security, including foreign currency deposits. Consider the dollar rate of return from a foreign currency deposit, $V_l^\$$, which is given by:

$$V_l^\$ = (1+V_l^l)(1+e_l^\$) - 1 \qquad \text{(A14)}$$

where V_l^l represents the nominal rate of interest on a currency deposit of country l, expressed in local currency l. Applying equation (A11) to foreign currency deposit, $V_l^\$$ gives

$$E(V_l^\$) = V_l^l + E(e_l^\$) = R + (1-\theta^l)\operatorname{var}(e_l^\$) + \theta^l \operatorname{cov}(e_l^\$; R_w^\$) \qquad \text{(A15)}$$

Equation (A15) is a relationship between two short-term nominal interest rates quoted in two different currencies or equivalently, between the short-maturity forward premia and the expected spot exchange rate. Equation (A15) shows that the well-known Uncovered Interest Parity (UIP) will not hold under risk aversion and in the absence of PPP. Rearrange equation (A15) obtaining,

$$E(e_l^\$) = R - V_l^l + (1-\theta^l)\operatorname{var}(e_l^\$) + \theta^l \operatorname{cov}(e_l^\$; R_w^\$) \qquad \text{(A16)}$$

Equation (A16) represents the rate of appreciation of currency l.

ENDNOTES

1. According to Hardouvelis, La Porta and Wizman (1994), “sentiments” refer to generalized optimistic or pessimistic animal spirits, not based on fundamentals.
2. There is a huge literature on what Lee, Shleifer, and Thaler (1991) denotes as “closed-end fund puzzle,” which is not the focus of current paper, and will be addressed in another paper.
3. Eun, Janakiramanan , and Senbet (2002) provides a theoretical asset pricing model for CECFs.
4. According to Forbes and Rigobon (1999), Dornbusch, Park and Claessens (1999), and Kaminsky and Reinhart (2000), previous empirical studies on contagion can be categorized by methodology into four groups: (1) the testing of significant increases in correlation (Calvo and Reinhart (1996), Baig and Goldfajn (1999), Forbes and Rigobon (1999, 2002) and Park and Song (1999)); (2) the testing of significance in innovation correlation (Baig and Goldfajn (1999)); (3) the testing of significant volatility spillover (Edwards (1998), Edwards and Susmel (1999)); (4) crisis prediction regression (Bae, Karolyi, and Stulz (2003), Eichengreen, Ross, and Wyplosz (1996), Kaminsky and Reinhart (2000), Van Rijckeghem and Weder (1999), Sachs, Tornell, and Velasco (1996)). None of the contagion studies mentioned above explicitly takes the time dependencies in the second moment into account. A recent paper by Bekaert, Harvey, and Ng (2005) applies three-stage univariate GARCH model to study contagion in equity markets by testing whether there is evidence of significant increase in cross market residual correlation during the crisis. Although they model conditional second moments, they cannot answer whether return shocks originated from one market will significantly affect the other markets during the crisis.
5. In the empirical tests of the model, S&P 500 index return is used to proxy the world market risk because it allows me to see how CECF and its NAV are affected by overall US market sentiment.
6. The four popular MGARCH models include the diagonal VECH model of Bollerslev, Engle, and Wooldridge (1988), the constant correlation (CCORR) model of Bollerslev (1990), the factor ARCH (FARCH) model of Engle, Ng, and Rothschild (1990), and the BEKK model of Engle and Kroner (1995).
7. The asymmetric volatility effects in variances and covariances have been documented in recent papers by, among others, Kroner and Ng (1998) and Bekaert and Wu (2000).
8. I assume that Asian crisis began in the first week of July 1997 and ended in the last week of October 1998.
9. As pointed out by De Santis and Gerad (1997), the conditional ICAPM is only a partial equilibrium model and the theory does not help identify the state variables that affect the prices of market and currency risks,

so inevitably any parameterization of the dynamics of $\lambda_{m,\,t-1}$ and $\lambda_{c,t-1}$ can be criticized for being ad hoc.

10. The CBOE's implied volatility index represents the implied volatility of an at-the-money option on the S&P 100 index with 22 trading days to expiration.
11. I use weekly data because NAV data is only available at weekly frequency, and select 06/13/03 as the end of sample period because it is the last observation for First Philippine fund.
12. Ideally it would be more efficient to estimate a full asymmetric MGARCH-M model for the CECF, NAV, FX, and US market returns for all five countries simultaneously, but it will be computationally infeasible since it requires to estimate a 16x16 variance-covariance matrix of asset returns in additional to the parameters in the conditional mean equations.
13. The total asymmetric volatility spillover effects before, during, and after the crisis reported in Table 5 are computed first by squaring the estimated individual asymmetric volatility spillover coefficients based on the volatility process specified in equation (4). I then add the squared asymmetric volatility coefficient before the crisis to the corresponding squared asymmetric volatility spillover coefficient during the crisis to obtain the total asymmetric volatility spillover effect *during* the crisis. To obtain the total asymmetric volatility spillover effect *after* the crisis, the corresponding squared asymmetric volatility coefficient after the crisis is then added to the total asymmetric volatility spillover effect during the crisis calculated previously.
14. Engle and Ng (1993) asymmetric tests include the sign bias, the negative size bias, and the positive size bias tests. The sign bias test examines the impact of positive and negative innovations on volatility not predicted by the model. The squared standardized residuals are regressed against a constant and a dummy S_t^- that takes the value of unity if ε_{t-1} is negative, and zero otherwise. The test is based on the t statistic for S_t^-. The negative (positive) size bias test examines how well the model captures the impact of large and small negative (positive) innovations, and it is based on the regression of the squared standardized residuals against a constant and $S_t^-\varepsilon_{t-1}$ ($(1-S_t^-)\varepsilon_{t-1}$). The computed t statistic for $S_t^-\varepsilon_{t-1}$ ($(1-S_t^-)\varepsilon_{t-1}$) is used in this test.
15. The derivation of the ICAPM is based on Dumas (1994). For more details of deriving the ICAPM, see Adler and Dumas (1983).
16. The relative PPP is expressed as $\pi_{US}^{\$} = (1+\pi_l^l)(1+e_l^{\$}) - 1$. If relative PPP holds, then $\pi_l^l + e_l^{\$} - \pi_{US}^{\$} = 0$. If relative PPP does not hold, then $\pi_l^l + e_l^{\$} - \pi_{US}^{\$} = \widehat{u}$ where $\widehat{u}$ are the deviations from relative PPP. If we assume local inflation is nonstochastic, then $\pi_{US}^{\$} = \pi_l^l = 0$. Thus, $e_l^{\$} = \widehat{u}$ which implies that the rate of exchange rate change is equal to the deviations from relative PPP.

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