Contagion in Emerging Market Equities

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Abstract

Adapting the definition from Forbes (2002), financial contagion is the significant increase in asset return correlation or transmission of volatility after a shock has occurred to a country or region. In this paper, we analyze country and regional equity data during the Thai Crisis of 1997 and the Credit Crisis of 2007. We derive regression models for equity returns and cross-sectional variance (dispersion) to determine relationships in these variables between key countries during the crisis periods. We find evidence of contagion between countries during the Thai Crisis and to lesser extent during the Credit Crisis.

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1 Introduction

Crises in financial markets can cause asset prices to plunge and may generate broader financial instability within a country. The sequential spread of a shock from one country or sector to another is generally described as contagion. Academic researchers are interested in identifying the channels of contagion, and a wide spectrum of definition regarding contagion exists. This paper adopts a previous definition from Forbes (2002): that "contagion is a significant increase in cross-market linkages after a shock to one country (or group of countries)". These cross-market linkages can be measured in "correlation of asset returns, probability of a speculative attack, or the transmission of shocks or volatility" (Forbes 2001). In this paper, we empirically investigate the existence of contagion within the Emerging Markets ("EM") during both the Thai Crisis and the Credit Crisis. We utilize Forbes's definition of contagion (2002) and, through regression analysis, determine its presence during major financial crises between 1996 and 2009.

Two crises[1] of interest are the Thai Crisis (1997-1998) and the Credit Crisis (2007-2009). The Thai Crisis, originating in Thailand after the devaluation of the Baht in July 1997, witnessed a sharp decline in returns across Southeast Asian nations, particularly Indonesia, Malaysia, the Philippines, and South Korea. Several authors including Chiang et al. (2007), Park and Song (2000), and Baig (1999) have concluded that these decreases in stock returns across several countries are evidence of contagion. The Credit Crisis (2007-2009) is a more recent crisis that can also be analyzed for contagion. Turmoil began in the United States as real estate prices crashed and large

[1] We also investigated the possible existence of contagion during the Brazil Election in 2002. The economic instability Brazil Crisis occurred from political discontent and debt problems. The results did not show relationships of significance and the results are provided in Appendices B and C.

banks had to write down billions of dollars of assets held in their portfolios (Brunnermeier 2009). This led to liquidity dry-ups and bankruptcies of major banks including Lehman Brothers, eventually spiraling to the largest financial crisis since the Great Depression (Brunnermeier 2009). Even though the Credit Crisis originated in the U.S., there is evidence of its effects spilling over into the emerging markets (Goldstein, 2009).

There exist various empirical methods to test for the presence of contagion. Sachs et al. (1996) argue that contagion can be detected by observing an increase in the cross-country correlation of returns. Forbes et al. (2002) develop a model that accounts for heteroskedasticity in returns data and conclude that there was no significant increase in correlation and, therefore, no contagion during the Thai Crisis. Chiang et al. (2007) argue the opposite using a dynamic conditional-correlation model, confirming a contagion effect. Other methods of contagion analysis include modeling international trade flow between countries during crises (Glick, 1999) and examining liquidity of bank holdings (Allen, 2000).

In this paper, in addition to exploring the relationship between equity returns in EM during the two crisis periods, we also investigate the relationship between the countries' cross sectional variances of returns. Cross sectional variance, which is often labeled dispersion, has been extensively analyzed in recent years and is of considerable importance to portfolio managers. Solnik and Roulet (2000) introduced dispersion as a cross-sectional measure of market correlation. Intuitively, low dispersion implies that individual stock returns within a country or index are very similar; while high dispersion suggests that the range of returns among equities is much wider. More recently, Yu and

Sharaiha (2007) decomposed dispersion into a combination of both time series volatility and correlation. They also show how dispersion measures can be used as a metric for excess returns. Egger and Jacob (2010) analyze dispersion with regards to portfolio concentration and construction. To our knowledge, there has been no previous work that utilizes dispersion to explore contagion effects.

To begin empirical analysis, we start out with the Capital Asset Pricing Model (CAPM) (Sharp 1964, Lintner 1965b) specification for individual stock returns. A model is derived in which one country's returns are assumed to be dependent on another country's returns one period earlier. In order to investigate the implication of crisis periods for cross-sectional variance, we decompose the sources of variation in returns to a market component and a country specific component, following the methodology set out by Campbell et al (2001). A model similar to the returns model is then derived. Thus, we attempt to determine whether trends in certain countries' returns (and dispersion) follow those of another country, after accounting for contemporaneous and lagged market-wide movements.

The presence of statistically significant relationships in lagged returns goes against the theory of the efficient markets hypothesis (Fama, 1970). This theory argues that equity markets are priced to fully reflect all available information, removing potential economic profits from trading. This implies that returns should not be predictable when trying to uncover return relationships across time. We believe that this theoretical assumption may be violated in the real world, especially over relatively short time periods and during market crises. Empirical work from Lim et al. (2008) found that the Thai Crisis adversely affected stock market efficiency of Asian countries.

In this paper, the detection of contagion is through applying indicator variables to the derived regression models. These regressions would indicate any statistically significant relationship in lagged returns that solely exist for dates specified as a crisis. Increases in these relationships between any two countries could signify contagion during that crisis. Our findings show significant relationships in returns and dispersion in EM during the Thai Crisis and, to a lesser extent, the Credit Crisis.

The remainder of the paper is structured as follows: in section two, we introduce the dataset used in the regression estimation. Section three provides the methodology, including model derivations for returns and dispersion as well as the use of indicator variables to delineate periods specific to each economic crisis. Section four presents our results for returns and dispersion during the Thai Crisis and Credit Crisis. Finally, section five concludes by summarizing our findings and suggesting areas of further research.

2 Data

2.1 Data Description

Weekly equity returns and dispersion in the Emerging Markets from July 1996 to July 2009 are obtained from the Russell Emerging Markets Indices by Russell Investments (Egger, 2010)[2]. The regions included in the indices are Asia, Europe, Africa, the Middle East, and Latin America. A full list of countries is included in Appendix A. The Russell data contains dividend-adjusted market capitalization in US Dollars for each stock and the total number of shares available for trading. For every country in the index, the data is used to determine asset prices, and thus, weekly returns and dispersion.

[2] Clean country level weekly data is provided by Professor Daniel Egger from the Center of Quantitative Modeling at Duke University.

Individual stock data is categorized by country code. Weekly returns for all the stocks with the same country code were grouped together to form weekly returns at the country level. Countries that had missing data or fewer than 15 stocks at any given period of time were formed into three regional clusters[3]: EMEA (Europe, Middle East, and Africa), Asia, and South America. The cross-sectional variance for a given week, defined as dispersion, $\gamma_{j,t}^2$, is also calculated from the data and grouped at the country and cluster level using the definition of dispersion from Equation 3.2.1 in section 3.2.

We focus our contagion analysis on the key countries of Thailand, China, Indonesia, and Brazil. Thailand is considered the source of the Thai Crisis, and thus is an obvious choice. We choose China because it is the largest economy among EM countries according to GDP during the entire time period of the data set[4]. Indonesia represents a Southeast Asian country that has a close geographic proximity and economic relationship with Thailand. We also choose Brazil, the largest South American country (by GDP), to evaluate the relationship between geographically disperse EM countries.

2.2 Dispersion Data

Figures 1 through 4 show the time series of dispersion, clustered by geographical regions[5]. We observe that dispersion levels spike at similar times in the same geographic regions. This is especially noticeable in Figure 1 of Southeast Asian countries. Comparing Figures 1 and 3, we see that South American countries' dispersion did not

[3] Countries in the regional clusters are listed in Appendix A.
[4] All Gross Domestic Product information is according to data from The World Bank website
[5] The plotted dispersion values are normalized to start at 0. Each country's first dispersion value is subtracted from its remaining dispersion values. This is so that all of the plots would have the same starting point.

exhibit as large of an increase as those of the Asian countries' dispersion between 1995 and 2000.

Figure 1. Southeast Asia Dispersion Time Series (1996-2009)

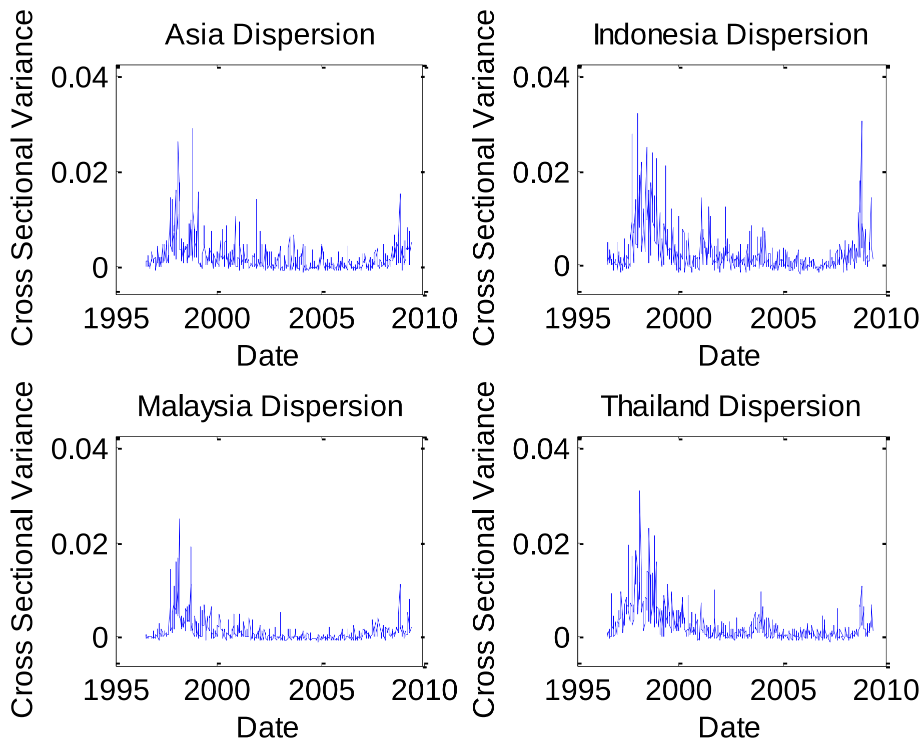


Figure 1 above shows that dispersion in Asia, Indonesia, and the Philippines all increase around the time of the Thai Crisis. Figure 2 contains the dispersion time series for the remaining Asian countries of China, India, Korea, and Taiwan. We see that neither India nor Taiwan experience the same sharp increase in dispersion in 1997, but China and Korea do. Figure 3 shows while South American countries' dispersion increased during the Thai Crisis, they reach even higher levels later in the sample period. Finally, Figure 4 contains the remaining countries in the EMEA region. Even though European and African countries' dispersion rose during the Thai Crisis, the levels did not reach the same magnitude as the Southeast Asian countries. Additionally, the dispersion levels in Turkey and EMEA increased to a similar or higher level in the few years before 2010.

Figure 2. Asian Dispersion Time Series (1996-2009)

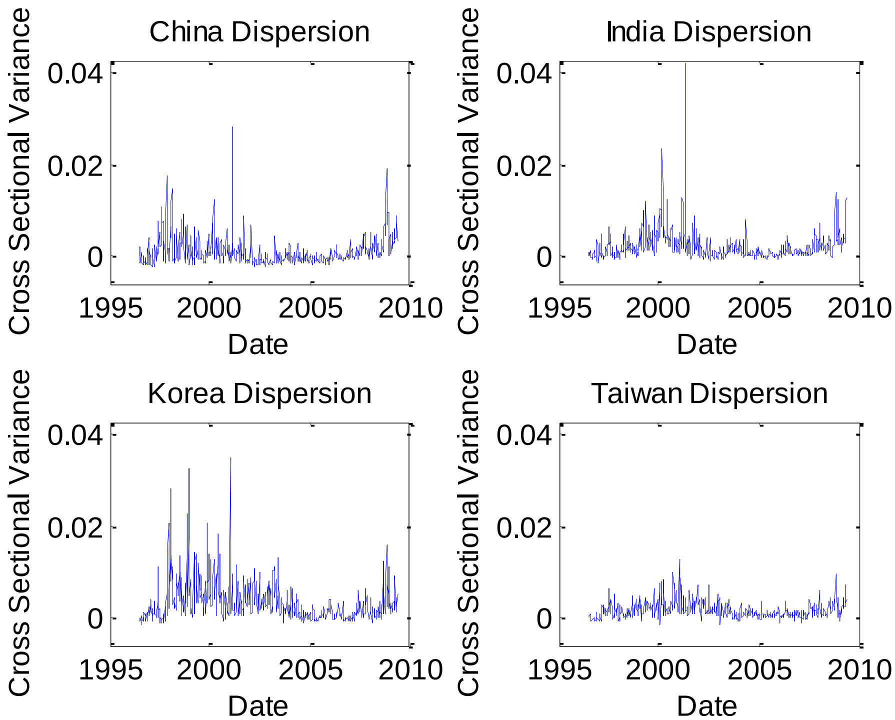


Figure 3. South America Dispersion Time Series (1996-2009)

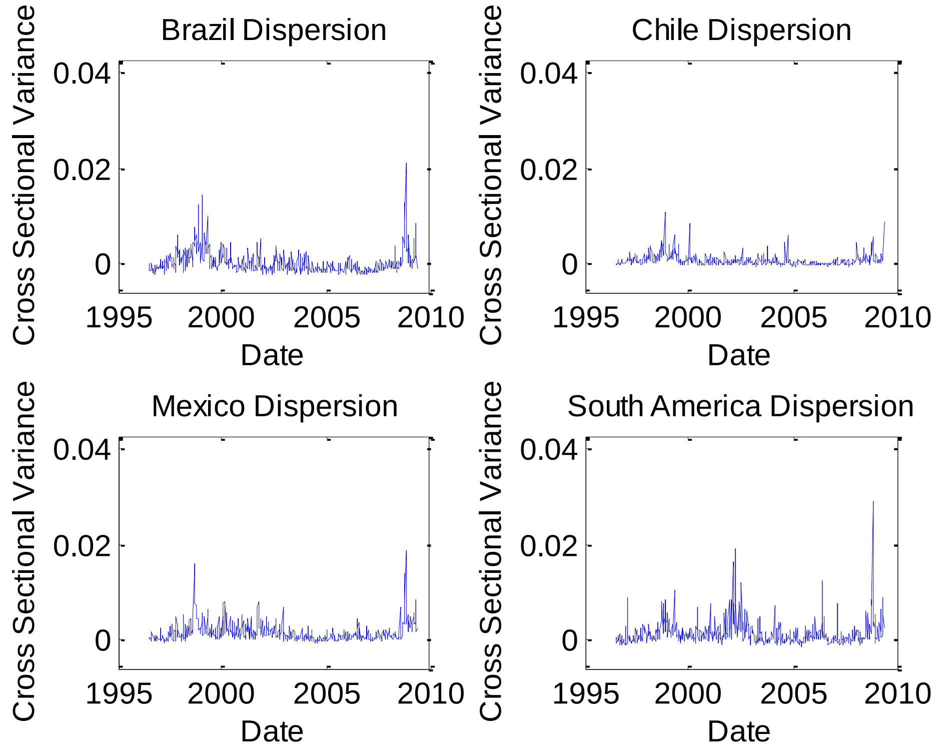
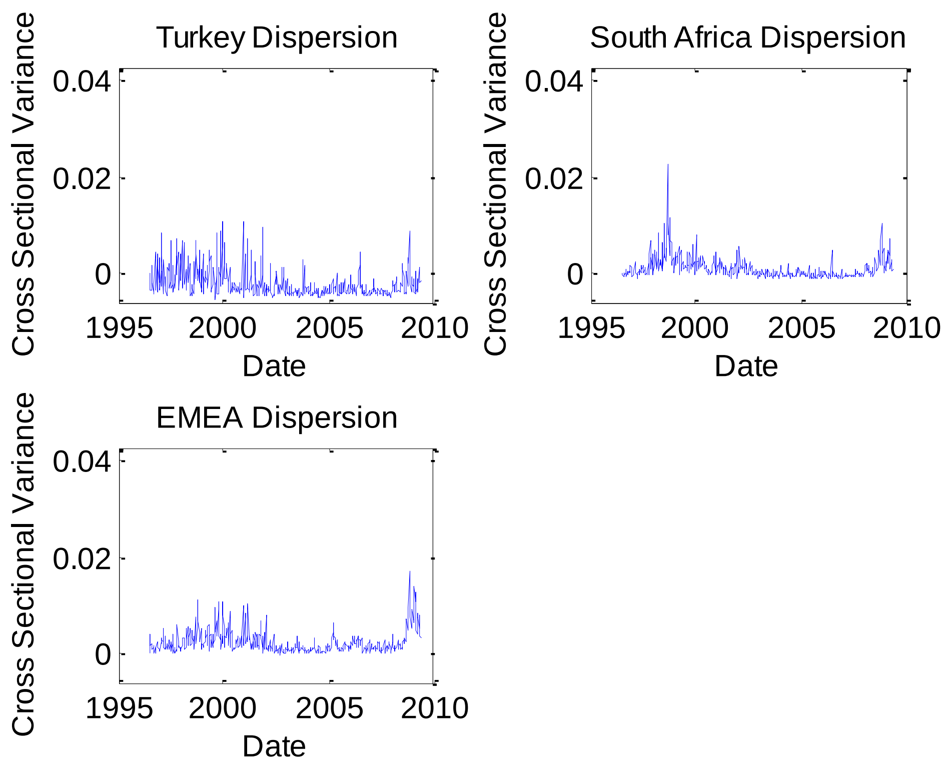


Figure 4. EMEA Country Dispersion Time Series (1996-2009)



3 Methodology

3.1 Derivation of Model for Returns

For the returns regressions, we begin with the CAPM model for an individual equity return k (Sharpe 1964, Lintner, 1965b). According to the CAPM, Equation 3.1.1 below, the relationship between the expected return of an asset and the expected market return is linear with slope, β_k, equal to the ratio of the covariance between the market and asset and the variance of the market:

$$E\left[r_{k,t}\right] = r_{f,t} + \beta_k\left(E\left[r_{m,t}\right] - r_{f,t}\right) + \varepsilon_{k,t} \qquad (3.1.1)$$

$$r_{k,t} = \alpha_k + \beta_k r_{m,t} + \varepsilon_{k,t} \quad \varepsilon_{k,t} \sim N(0, \sigma_\varepsilon^2) \qquad (3.1.2)$$

To empricially implement the CAPM, we utilize Equation 3.1.2 (Campbell, 1996) which is a single factor linear regression between an individual asset and the overall return on the market[6]. $r_{k,t}$ is the return of an asset k and time t, α_k is the intercept, β_k is the coefficient for asset k, $r_{m,t}$ is the overall market return at time t, and $\varepsilon_{k,t}$ is the error term for asset k at time t. We also make the following assumptions:

$$corr(r_{m,t}, \varepsilon_{k,t}) = 0$$

$$corr(\alpha_k, \varepsilon_k) = 0$$

$$corr(\beta_k, \varepsilon_k) = 0$$

$$corr(\alpha_k, \beta_k) = 0$$

[6] We assume that the weekly risk-free return is zero.

We aggregate individual stock return data to the country level. This step stems from a restriction in our data source. Our data consists of returns only for each country at time t, therefore we cannot estimate the individual asset regressions. For country j with N stocks, let r_{jk} represent the individual asset k in country j. We can find the equal weighted mean return by using:

$$\bar{r}_{j,t} = \frac{1}{N}\sum_{k=1}^{N} r_{jk,t}$$

$$\bar{r}_{j,t} = \frac{1}{N}\sum_{k=1}^{N} \left(\alpha_{\mathrm{jk}} + \beta_{\mathrm{jk}} r_{m,t} + \varepsilon_{\mathrm{jk}t}\right)$$

$$\bar{r}_{j,t} = \bar{\alpha}_j + \bar{\beta}_j r_{m,t} + \bar{\varepsilon}_{j,t} \qquad (3.1.3)$$

We can now consider two countries i and j and define their equal weighted mean return:

$$\bar{r}_{i,t} = \bar{\alpha}_i + \bar{\beta}_i r_{m,t} + \bar{\varepsilon}_{i,t} \qquad (3.1.4)$$

$$\bar{r}_{j,t} = \bar{\alpha}_j + \bar{\beta}_j r_{m,t} + \bar{\varepsilon}_{j,t} \qquad (3.1.5)$$

In order to analyze the effect of country j's return on those of country i, we would like to run a regression of the error term of country i on that of country j, which controls for the effect of the market factor:

$$\bar{\varepsilon}_{i,t} = \xi_0 + \xi_1 \bar{\varepsilon}_{j,t} + v_t \qquad (3.1.6)$$

However, as $\bar{\varepsilon}_{i,t}$ and $\bar{\varepsilon}_{j,t}$ are unobservable in the real world, we must rewrite Equation 3.1.6 in terms of the observable variables in Equations 3.1.4 and 3.1.5.

$$\bar{\varepsilon}_{i,t} = \bar{r}_{i,t} - \bar{\alpha}_i - \bar{\beta}_i r_{m,t} \qquad (3.1.7)$$

$$\bar{\varepsilon}_{j,t} = \bar{r}_{j,t} - \bar{\alpha}_j - \bar{\beta}_j r_{m,t} \tag{3.1.8}$$

Substituting Equations 3.1.7 and 3.1.8 into Equation 3.1.6, we have:

$$\bar{r}_{i,t} - \bar{\alpha}_i - \bar{\beta}_i r_{m,t} = \xi_0 + \xi_1(\bar{r}_{j,t} - \bar{\alpha}_j - \bar{\beta}_j r_{m,t}) + v_t$$

$$\bar{r}_{i,t} = \xi_0 - \xi_1\bar{\alpha}_j + \bar{\alpha}_i - (\xi_1\bar{\beta}_j + \bar{\beta}_i)r_{m,t} + \xi_1\bar{r}_{j,t} + v_t$$

We now have a regression for the equal weighted mean return for country i at time t in terms of the market return and the equal weighted mean return of country j. Let:

$$\phi_0 = \xi_0 - \xi_1\bar{\alpha}_j + \bar{\alpha}_i$$

$$\lambda_1 = -(\xi_1\bar{\beta}_j + \bar{\beta}_i)$$

$$\xi_1 = \xi_1$$

Then the final equation will be:

$$\bar{r}_{i,t} = \phi_0 + \lambda_1 r_{m,t} + \xi_1\bar{r}_{j,t} + v_t \tag{3.1.9}$$

Comparing Equation 3.1.9 with Equation 3.1.6 we note that the coefficient ξ_1 remains unchanged in the transformation. Thus, testing testing the null hypothesis for $\xi_1 = 0$ versus the alternative of $\xi_1 \neq 0$, that is, testing the impact of the residual of country j on country i, is equivalent to testing the impact of the return in country j on that of country i in the transformed Equation 3.1.9.

We believe the effects of a crisis from country j will not effect the returns of country i without having a time lag. We then incorporate a time lag of one period and perform a similar substitution, except with:

$$\bar{\varepsilon}_{i,t} = \bar{r}_{i,t} - \bar{\alpha}_i - \bar{\beta}_i r_{m,t} \tag{3.1.10}$$

$$\bar{\varepsilon}_{j,t-1} = \bar{r}_{j,t-1} - \bar{\alpha}_j - \bar{\beta}_j r_{m,t-1} \tag{3.1.11}$$

We then substitute Equations 3.1.10 and 3.1.11 into Equation 3.1.12 below:

$$\bar{\varepsilon}_{i,t} = \xi_0 + \xi_1 \bar{\varepsilon}_{j,t-1} + v_t \tag{3.1.12}$$

$$\bar{r}_{i,t} - \bar{\alpha}_i - \bar{\beta}_i r_{m,t} = \xi_0 + \xi_1(\bar{r}_{j,t-1} - \bar{\alpha}_j - \bar{\beta}_j r_{m,t-1}) + v_t$$

$$\bar{r}_{i,t} = \xi_0 - \xi_1\bar{\alpha}_j + \bar{\alpha}_i + \bar{\beta}_i r_{m,t} - \xi_1\bar{\beta}_j r_{m,t-1} + \xi_1\bar{r}_{j,t-1} + v_t$$

Let:

$$\phi_0 = \xi_0 - \xi_1\bar{\alpha}_j + \bar{\alpha}_i$$

$$\lambda_t = \bar{\beta}_i$$

$$\lambda_{t-1} = -\xi_1\bar{\beta}_j$$

$$\xi_1 = \xi_1$$

Then our equation for return of country j on the market return and the return of country i with lag 1 is:

$$\bar{r}_{i,t} = \phi_0 + \lambda_t r_{m,t} + \lambda_{t-1} r_{m,t-1} + \xi_1 \bar{r}_{j,t-1} + v_t \tag{3.1.13}$$

Again, notice that the coefficient ξ_1 in Equation 3.1.13 is the same as ξ_1 from Equation 3.1.12. This means that, testing for significance of ξ_1 in the derived regressions, and testing the null hypothesis for $\xi_1 = 0$ versus the alternative of $\xi_1 \neq 0$ are equivalent.

3.2 Derivation of Model for Dispersion

The mathematical definition of cross sectional variance is:

$$\gamma_t^2 = \frac{1}{N}\sum_{k=1}^{N} (r_{k,t} - \bar{r}_t)^2 \qquad (3.2.1)$$

N is the number of assets while $\bar{r}_t$ is the cross sectional average return at time t.

Taking Equations 3.2.1 and and the cross-sectional average[7] shown in Equation 3.1.3 and substituting them into the definition of γ_t^2, we get:

$$\gamma_t^2 = \frac{1}{N}\sum_{k=1}^{N} \{\alpha_k + \beta_k r_{m,t} + \varepsilon_{k,t} - (\bar{\alpha} + \bar{\beta} r_{m,t})\}^2$$

$$= \frac{1}{N}\sum_{k=1}^{N} \{(\alpha_k - \bar{\alpha}) + (\beta_k - \bar{\beta}) r_{m,t} + (\varepsilon_{k,t})\}^2$$

$$= \frac{1}{N}\sum_{k=1}^{N} \{(\alpha_k - \bar{\alpha})^2 + (\beta_k - \bar{\beta})^2 r_{m,t}^2 + (\varepsilon_{k,t})^2 + 2(\alpha_k - \bar{\alpha})(\beta_k - \bar{\beta}) r_{m,t}$$

$$+ 2(\alpha_k - \bar{\alpha})(\varepsilon_k) + 2(\beta_k - \bar{\beta})(\varepsilon_k) r_{m,t}\}$$

Using the definitions for variance and covariance, and the orthogonality assumptions, we can further simplify the formula for cross sectional variance of returns.

$$\gamma_t^2 = \frac{1}{N}\sum_{k=1}^{N} (\alpha_k - \bar{\alpha})^2 + \frac{1}{N}\sum_{k=1}^{N} (\beta_k - \bar{\beta})^2 r_{m,t}^2 + \frac{1}{N}\sum_{k=1}^{N} \varepsilon_k^2$$

We can simplify the notation by rewriting the cross-sectional variance as a function of squared market returns, $r_{m,t}^2$, and cross sectional variance of the residual, $\sigma_{\varepsilon,t}^2$:

[7] $E[\varepsilon] = 0$ from our initial assumptions about the distribution of ε.

$$\gamma_t^2 = \varphi_0 + \varphi_1 r_{m,t}^2 + \sigma_{\varepsilon,t}^2 \quad (3.2.2)$$

Since Equation 3.2.2 provides the form of cross sectional variance for a single country, we can then consider γ_t^2 for countries i and j; let $\gamma_{i,t}^2$ and $\gamma_{j,t}^2$ be the cross sectional volatilities for countries i and j respectively.

$$\gamma_{i,t}^2 = \varphi_{i,0} + \phi_{i,1} r_{m,t}^2 + \sigma_{\varepsilon_i,t}^2 \quad (3.2.3)$$

$$\gamma_{j,t}^2 = \varphi_{j,0} + \varphi_{j,1} r_{m,t}^2 + \sigma_{\varepsilon_j,t}^2 \quad (3.2.4)$$

As with the derviations of our return model above, we wish to separate market effects from country-specific effects for dispersion as well. To analyze the impact of the cross sectional variance of country j on that of country i, we would like to run the equation below:

$$\sigma_{\varepsilon_i,t}^2 = \psi_0 + \psi_1 \sigma_{\varepsilon_j,t}^2 + u_t \quad (3.2.5)$$

However, because we cannot observe $\sigma_{\varepsilon_i,t}^2$ and $\sigma_{\varepsilon_j,t}^2$, we must rewrite Equations 3.2.3 and 3.2.4 such that we are able to derive a regression equation in terms of the observable values:

$$\sigma_{\varepsilon_i,t}^2 = \gamma_{i,t}^2 - \varphi_{i,0} - \varphi_{i,1} r_{m,t}^2 \quad (3.2.6)$$

$$\sigma_{\varepsilon_j,t}^2 = \gamma_{j,t}^2 - \varphi_{j,0} - \varphi_{j,1} r_{m,t}^2 \quad (3.2.7)$$

Substituting Equations 3.2.6 and 3.2.7 into Equation 3.2.5, we derive a regression for cross sectional variance of country i, $\gamma_{i,t}^2$ with respect to a market squared term, $r_{m,t}^2$, and the cross sectional variance of country j, $\gamma_{j,t}^2$:

$$\gamma_{i,t}^2 - \varphi_{i,0} - \varphi_{i,1} r_{m,t}^2 = \psi_0 + \psi_1(\gamma_{j,t}^2 - \varphi_{j,0} - \varphi_{j,1} r_{m,t}^2) + u_t$$

$$\gamma_{i,t}^2 = \psi_0 - \psi_1\varphi_{j,0} + \varphi_{i,0} - (\psi_1\varphi_{j,1} + \varphi_{i,1}) r_{m,t}^2 + \psi_1\gamma_{j,t}^2 + u_t$$

We now have the cross sectional variance for country i in terms of the squared market return and the cross sectional variance of country j. Let:

$$\eta_0 = \psi_0 - \psi_1\varphi_{j,0} + \varphi_{i,0}$$

$$\theta_{\mathrm{t}} = -(\psi_1\varphi_{j,1} + \varphi_{i,1})$$

$$\psi_1 = \psi_1$$

We have the final equation of:

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \psi_1\gamma_{j,t}^2 + u_t \qquad (3.2.8)$$

If we allow for a lag of 1 period, Equation 3.2.5 will be modified to become:

$$\sigma_{\varepsilon_i,t}^2 = \psi_0 + \psi_1\sigma_{\varepsilon_j,t-1}^2 + u_t \qquad (3.2.9)$$

Once again, substituting the formulas for $\sigma_{j,t-1}^2$ and $\sigma_{i,t}^2$ into Equation 3.2.9 results in:

$$\gamma_{i,t}^2 - \varphi_{i,0} - \varphi_{i,1} r_{m,t}^2 = \psi_0 + \psi_1(\gamma_{j,t-1}^2 - \varphi_{j,0} - \varphi_{j,1} r_{m,t-1}^2) + u_t$$

$$\gamma_{i,t}^2 = \psi_0 - \psi_1\varphi_{j,0} + \varphi_{i,0} + \varphi_{i,1} r_{m,t}^2 - \psi_1\varphi_{i,1} r_{m,t-1}^2 + \psi_1\gamma_{m,t-1}^2 + u_t$$

We obtain a regression for the cross sectional variance of country i in terms of the squared market return at time t, the squared market return at time $t-1$, the cross sectional variance of country j at time $t-1$. Let:

$$\eta_0 = \psi_0 - \psi_1\varphi_{j,0} + \varphi_{i,0}$$

$$\theta_t = \varphi_{i,1}$$

$$\theta_{t-1} = -\psi_1\varphi_{i,1}$$

$$\psi_1 = \psi_1$$

We have the cross sectional variance of country i in terms of the squared market return from time t and $t-1$ as well as the cross sectional variance of country i from the previous period:

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \theta_{t-1} r_{m,t-1}^2 + \psi_1 \gamma_{j,t-1}^2 + u_t \qquad (3.2.10)$$

In both Equations 3.2.8 and 3.2.10, the coefficient, ψ_1, is the same value from Equations 3.2.5 and 3.2.9 respectively. The analysis of ψ_1 from Equations 3.2.8 and 3.2.10 is equivalent to the analysis of ψ_1 in Equations 3.2.5 and 3.2.9.

3.3 Regression Models

The following equations are used for regressions on returns (Equation 3.3.1) and dispersion (Equation 3.3.2). Both equations are multivariate linear regression models used on the entire sample time period (1996 to 2009).

$$r_{i,t} = \phi_0 + \lambda_t r_{m,t} + \lambda_{t-1} r_{m,t-1} + \xi_1 r_{j,t-1} + v_{i,t} \qquad (3.3.1)$$

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \theta_{t-1} r_{m,t-1}^2 + \psi_1 \gamma_{j,t-1}^2 + u_{i,t} \qquad (3.3.2)$$

$r_{i,t}$ is the weekly returns for country $i$at time t and $\gamma_{i,t}^2$ is the dispersion for country i at time t. ϕ_0 and η_0 are the intercepts while $\lambda_t$and θ_t represent the coefficients for the market factors, $r_{m,t}$ and $r_{m,t}^2$ respectively. ξ_1 is the coefficient for the return of country j

at time $t-1$, $r_{j,t-1}$. ψ_1 is the coefficient for lagged dispersion of country j, $\gamma^2_{j,t-1}$. Finally, $v_{i,t}$ and $u_{i,t}$ are the respective regression error terms.

The returns model in Equation 3.3.1 takes into account the market factors that affect country returns. We assume that contemporaneous and lagged market factors have significant relationships with both the explanatory country and the target country. Only by controlling for the market factor can the coefficient of the explanatory country ξ_1 have meaningful interpretation. The same analysis applies for Equation 3.3.2.We run the regression models across the entire data sample to identify statistically significant relationships between the weekly returns or dispersion of one country on next week's returns or dispersion of a different country.

3.4 Indicator Regression Models

Equations 3.4.1 and 3.4.2 were used to determine the relationship between the emerging markets' returns and the dispersion of Brazil, China, and Thailand during the Thai Crisis (1997-1999) and the Credit Crisis (2007).

$$r_{i,t} = \phi'_0 + \lambda'_t r_{m,t} + \lambda'_{t-1} r_{m,t-1} + \xi'_1 r_{j,t-1} + \tau'_t \boldsymbol{I} r_{m,t} + \tau'_{t-1} \boldsymbol{I} r_{m,t-1} + \xi'_2 \boldsymbol{I} r_{j,t-1} + v'_{i,t} \tag{3.4.1}$$

$$\gamma^2_{i,t} = \eta'_0 + \theta'_t r^2_{m,t} + \theta'_{t-1} r^2_{m,t-1} + \psi'_1 \gamma^2_{j,t-1} + \omega'_t \boldsymbol{I} r^2_{m,t} + \omega'_{t-1} \boldsymbol{I} r^2_{m,t-1} + \psi'_2 \boldsymbol{I} \gamma^2_{j,t-1} + u'_{i,t} \tag{3.4.2}$$

The same coefficients from Equations 3.3.1 and 3.3.2 remain in models with an indicator variable and are given the same interpretations. The additional terms of τ'_t and ω'_t represent the coefficients for market factors, $r_{m,t-1}$ and $r^2_{m,t-1}$ with an indicator variable. ξ'_2 is the coefficient for lagged returns of country j during time periods of crisis, ψ'_2 represents the respective coefficient for dispersion. The indicator variable takes the value of 1 when country j is in a crisis period and 0 during non-crisis, or normal, periods.

The dates when the indicator variable equals 1 are given in Table 1 below. The Thai Crisis began on 7/2/1997 when the Thai baht devalued and ended on 12/30/1998[8]. The Credit Crisis dates were selected by identifying the market peak of the S&P500 index with the end date being identified as the trough.

Table 1: Crises Start and End Dates

Crisis	Start Date	End Date
Thai	7/2/1997	12/30/1998
Credit	4/11/2007	3/9/2009

The indicator variable separates the relationships during the crisis period from the remaining time periods. The inclusion of indicator variables reflects the assumption that both market effects and country-specific effects between countries change during the time of a crisis. A statistically significant estimate of ξ_2' and ψ_2' would provide support for this assumption.

3.5 Exponential Weighted Moving Average Correlations

An exponentially weighted moving average (EWMA) model, or exponential smoother, is used to calculate the covariance between the returns of two given countries (Engle 2009)[9]. The EWMA model uses a weighted average of the most recent observation in estimating the conditional covariance:

$$h_{i,j,t} = \kappa h_{i,j,t-1} + (1-\kappa) r_{i,t-1} r_{j,t-1}' \tag{3.5.1}$$

$h_{i,j,t}$ is the calculated exponentially weighted moving average covariance. *t* is the time and *r* is the weekly return for a given country. The unknown κ in the model is chosen, by convention, to be 0.94 for weekly return data[10]. The correlation in the first period is the

[8] Thai Crisis dates from Chiang et al. (2007)
[9] The EWMA was popularized by RiskMetricks (Longerstaey, 1996)
[10] κ = .94 is the RiskMetrics model developed by J.P Morgan

sample covariance of the entire data set. Correlations, ρ, are calculated using Equation 3.5.2 below and used to in the exploratory data analysis for returns.

$$\rho_{i,j,t} = \frac{h_{i,j,t}}{\sqrt{h_{i,j,t} h_{j,j,t}}} \tag{3.5.2}$$

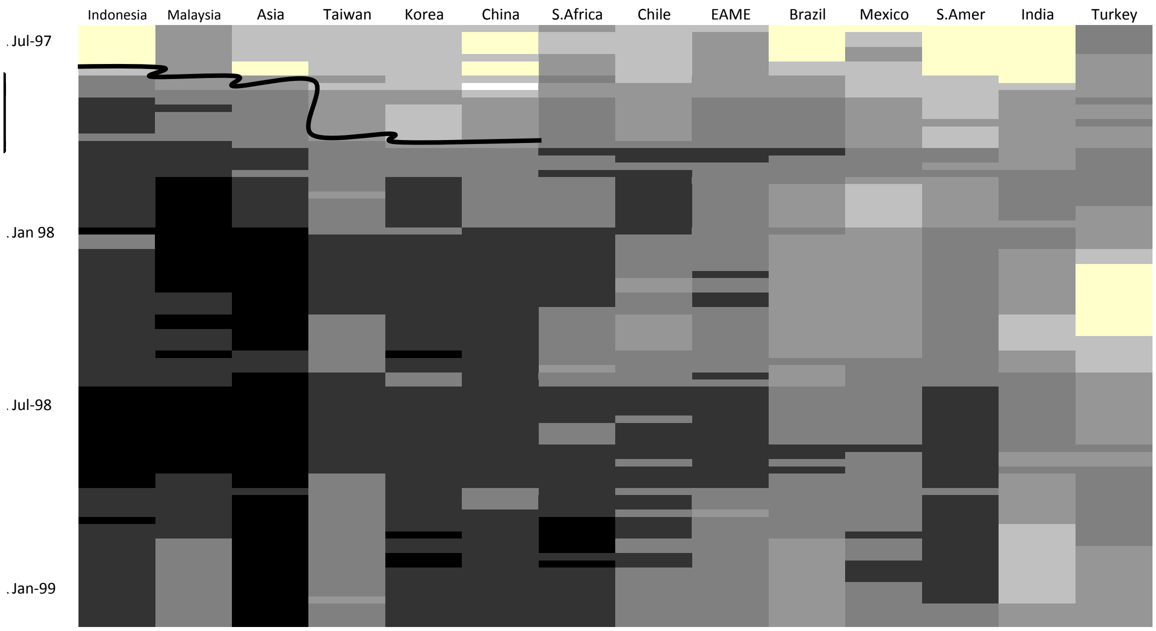
4 Results

4.1 Return Results

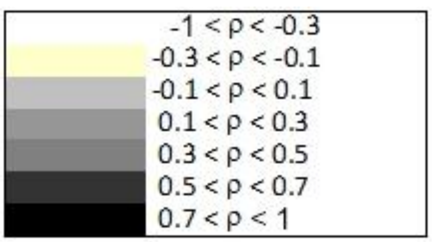
4.1.1 Exploratory Analysis

We perform exploratory analysis on country returns by analyzing the trends in correlations estimated from the equations 3.5.1 and 3.5.2 between Thailand and each country (or cluster) during the Thai crisis period. The economic downturn spread to neighboring Asian countries and contributed to financial contagion, described by Chiang et al. (2007), as can be seen in Figure 5. Correlation levels during the Thai Crisis period are graphed using a gradient heat map. Regional clusters of EMEA, Asia, and South America are also included. During the crisis period, it appears that return correlations have increased over time. The increase in correlation rolls through Asia as indicated by the wavy black line. We will use Equations 3.3.1 and 3.4.1 to assess whether financial instability in Thailand during the Thai crisis period increased the predictability between weekly returns in Asian countries.

Figure 5. Correlation Levels with Thailand during Thai Crisis

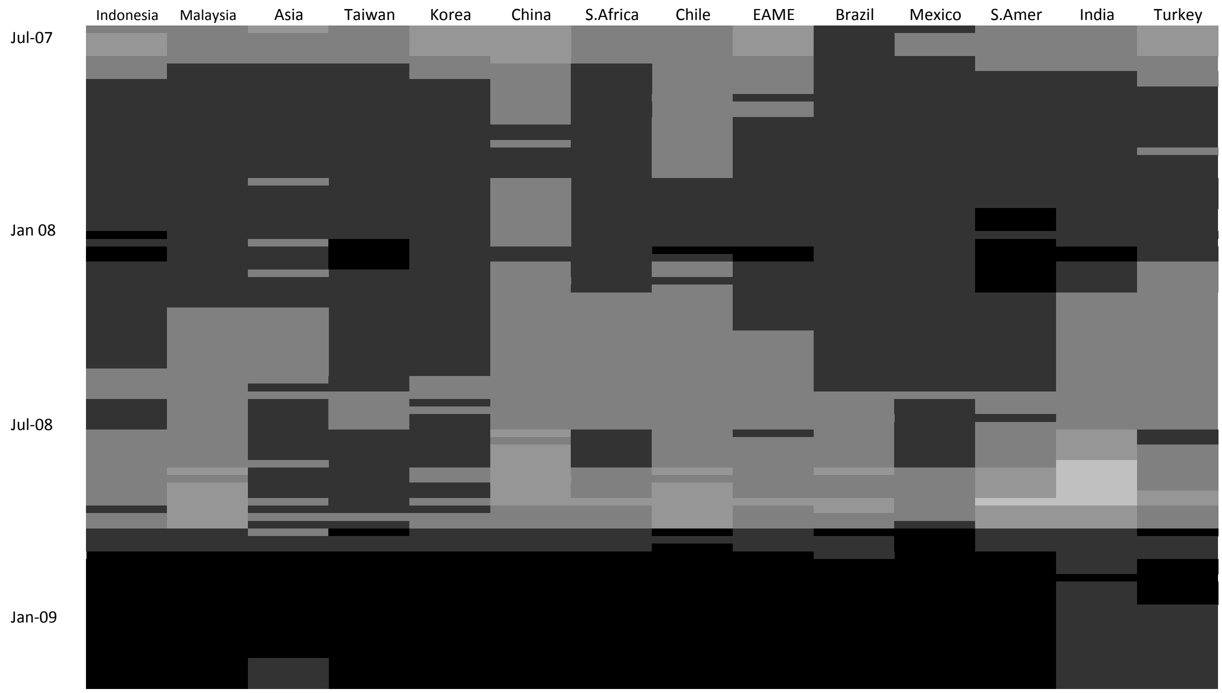


Correlation (ρ) Legend: Darker = higher correlation

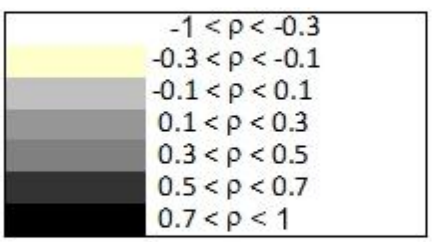


In Figure 6, the EWMA correlations during the Credit Crisis are provided using the same methodology as in Figure 5. As seen in Figure 6, the correlations during the period of the Credit Crisis were extremely high for not only Asian countries but also countries in other geographic regions. During the Thai Crisis on the other hand, only Asian countries experienced increased return correlations. Also, correlations across all of EM were generally higher prior to the Credit Crisis, relative to levels around the time of the Thai Crisis.

Figure 6. Weekly Returns Correlation Levels with China during Credit Crisis



Correlation (ρ) Legend: Darker = higher correlation



4.1.2 Thai Crisis Return Results

Table 2 summarizes the regression results from using Equations 3.3.1 and 3.4.1 to analyze the Thai Crisis from July 1997 to December 1998. Selected results for China, Indonesia, and Brazil are shown with relevant estimated coefficients for the regression with lagged Thai returns as an explanatory variable[11]. Panel A of Table 2 provides the coefficients for the relationship between each "dependent" country and Thailand's lagged returns for the entire sample period given by ξ_1 (Equation 3.3.1), with the adjusted R^2 of

[11] Complete tables can be found in the Appendix B.

the regression model in the next column. Panel B contains the coefficients for the indicator regression model (in Equation 3.4.1) and the adjusted R^2.

$$r_{i,t} = \phi_0 + \lambda_t r_{m,t} + \lambda_{t-1} r_{m,t-1} + \xi_1 r_{j,t-1} + v_{i,t} \quad (3.3.1)$$

$$r_{i,t} = \phi_0' + \lambda_t' r_{m,t} + \lambda_{t-1}' r_{m,t-1} + \xi_1' r_{j,t-1} + \tau_t' \boldsymbol{I} r_{m,t} + \tau_{t-1}' \boldsymbol{I} r_{m,t-1} + \xi_2' I r_{j,t-1} + v_{i,t}' \quad (3.4.1)$$

Table 2: Weekly Returns Regression with Thailand during Thai Crisis – July 1997 to December 1998

Panel A			Panel B		
Country	ξ_1	$Adj. R^2$	ξ_1'	ξ_2'	$Adj. R^2$
China	0.1165 (0.0866)	0.3765	-0.0230 (0.0416)	0.2581* (0.0929)	0.5275
Indonesia	0.0204 (0.0612)	0.4075	0.0116 (0.0574)	0.2275 (0.1281)	0.4150
Brazil	-0.0084 (0.0622)	0.4079	0.0204 (0.0415)	-0.1851* (0.0925)	0.4397

* significant at the .05 level

By comparing ξ_1 to ξ_1' and ξ_2', we can contrast the relationship between the returns of China, Indonesia, and Brazil, relative to Thailand's lagged returns, both for the entire sample period and for the Thai Crisis period. The statistically significant ξ_2' indicates that Thailand's returns have additional explanatory power on the returns of China and Brazil during the crises period, while lack of significance in ξ_1 indicates lack of explanatory power of Thailand's returns on the "dependent countries" over the sample period as a whole. From Table 2, it thus appears that there is an increased lagged return relationship with Thailand for both China and Brazil during the crisis.

Insights regarding the nature of the return relationships can be derived not only from the statistical significance of the indicator variable ξ_2' but also from the sign and relative magnitudes of the coefficients. During times of crisis, when the indicator variable is 1, the total magnitude of the relationship with lagged Thailand returns is the sum of magnitudes of $\xi_1'$and ξ_2'. The magnitude of ξ_2' indicates the extent to which the dependent country is additionally affected by Thai returns during the crisis period. As seen in Table 2 for China and Brazil, it appears that there is an increased return relationship for both China and Brazil during the crisis. The amplification of the relationships with lagged Thai returns would indicate predictable return relationships derived from declining equity returns spreading to other countries during a crisis. Furthermore, the positive sign of the coefficient for China suggests China's returns move in an amplified direction compared with Thailand's returns. There is also meaningful increase in the adjusted R^2 between the two models, which provides further evidence of an increase in the impact of lagged Thai returns on China during the crisis. The negative coefficient in the case of Brazil might indicate a change in portfolio allocations in emerging markets during the crisis, with investors assuming that all of Asia would be affected by Thai currency collapse, but that South America's geographic distance would immunize it from the Asian crisis.

The lack of significance of ξ_2' in Indonesia indicates the absence of additional explanatory power of Thailand's returns on Indonesia's during the crisis. While correlations between Indonesia and Thailand appear to have increased based on Figure 5, the lack of an amplified relationship during a crisis may be explained close geographic proximity of Thailand and Indonesia. Impact from Thailand's returns on Indonesia's happen on an almost contemporaneous basis, such as hours or days, rather than the weekly returns that we use in our analysis[12]. This may explain the lack of significance on all the coefficients in the Indonesia regressions. All in all, the significant relationships

[12] Analysis on higher frequency data could be part of future studies.

that exist between Thailand with China and Brazil point to contagion that does not exist in non-crisis periods.

4.1.3 Credit Crisis Return Results

In order to analyze the Credit Crisis period, we use Equations 3.3.1 and 3.4.1 for two explanatory countries, Thailand and China. We use Thailand to facilitate comparison with the Thai Crisis results.

$$r_{i,t} = \phi_0 + \lambda_t r_{m,t} + \lambda_{t-1} r_{m,t-1} + \xi_1 r_{j,t-1} + v_{i,t} \quad (3.3.1)$$

$$r_{i,t} = \phi_0' + \lambda_t' r_{m,t} + \lambda_{t-1}' r_{m,t-1} + \xi_1' r_{j,t-1} + \tau_t' \boldsymbol{I} r_{m,t} + \tau_{t-1}' \boldsymbol{I} r_{m,t-1} + \xi_2' I r_{j,t-1} + v_{i,t}' \quad (3.4.1)$$

Table 3: Weekly Returns Regression with Thailand during Credit Crisis – April 2007 to March 2009

	Panel A		Panel B		
Country	ξ_1	$Adj. R^2$	ξ_1'	ξ_2'	$Adj. R^2$
China	0.0227 (0.0378)	0.4851	0.0411 (0.0395)	-0.1303 (0.1474)	0.4861
Indonesia	0.0662 (0.0515)	0.3764	0.0781 (0.0541)	-0.1975 (0.2016)	0.3747
Brazil	-0.0212 (0.0370)	0.4082	-0.0219 (0.0386)	-0.0209 (0.1440)	0.4129

* significant at the .05 level

Table 3 displays regression results for the Credit Crisis, with Thailand as the explanatory variable. The lack of significance in ξ_2' any of the coefficients indicates no significant relationships with Thailand's lagged returns during this period. The inference is supported by the almost identical adjusted R^2 between the two models.

Table 4: Weekly Returns Regression with China during Credit Crisis – April 2007 to March 2009					
	Panel A		Panel B		
Country	ξ_1	$Adj. R^2$	ξ_1'	ξ_2'	$Adj. R^2$
Thailand	-0.0560 (0.0396)	0.4155	-0.0488 (0.0410)	-0.0038 (0.1443)	0.3916
Indonesia	-0.0587 (0.0528)	0.3760	-0.0402 (0.0552)	-0.2196 (0.1941)	0.3747
Brazil	0.0572 (0.0379)	0.4099	0.0341 (0.0393)	0.2233 (0.1382)	0.4165
* significant at the .05 level					

Table 4 displays regressions with China's returns as the independent variable. Here again we observe no significance in any of the indicator variables. The likely explanation is that the Credit Crisis did not originate in these countries but in fact, had originated in the United States. Weekly returns in China therefore had no additional significant explanatory power during this period. Similar to Table 3, we again observe that the adjusted R^2 did not change between the two models. Unlike the Thai Crisis, the lack of significant findings in returns fails to show evidence for contagion during the Credit Crisis.

4.2 Dispersion Results

4.2.1 Thai Crisis Dispersion Results

Tables 5, below, summarizes the regression results from Equations 3.3.2 and 3.4.2 for the Thai Crisis period, with Thailand as the explanatory variable. Again, selected results for China, Indonesia, and Brazil are shown with relevant coefficients[13]. The following regressions are used:

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \theta_{t-1} r_{m,t-1}^2 + \psi_1 \gamma_{j,t-1}^2 + u_{i,t} \quad (3.3.2)$$

[13] Complete Tables can be found in Appendix C.

$$\gamma_{i,t}^2 = \eta_0' + \theta_t^{'} r_{m,t}^2 + \theta_{t-1}^{'} r_{m,t-1}^2 + \psi_1^{'} \gamma_{j,t-1}^2 + \omega_t^{'} \boldsymbol{I} r_{m,t}^2 + \omega_{t-1}^{'} \boldsymbol{I} r_{m,t-1}^2 + \psi_2^{'} \boldsymbol{I} \gamma_{j,t-1}^2 + u_{i,t}^{'} \quad (3.4.2)$$

Table 5: Weekly Dispersion Regression with Thailand during Thai Crisis – July 1997 to December 1998

	Panel A		Panel B		
Country	ψ_1	$Adj.R^2$	ψ_1'	ψ_2'	$Adj.R^2$
China	0.1570* (0.0265)	0.3119	0.2374* (0.0450)	-0.1721* (0.0484)	0.1213
Indonesia	0.4439* (0.0402)	0.3171	0.1036 (0.0661)	0.2881* (0.0710)	0.3824
Brazil	0.1733* (0.0206)	0.3198	0.1814* (0.0353)	0.0390 (0.0379)	0.3320

* significant at the .05 level

The second column provides summary data for Equation 3.3.2. After accounting for market effects, all three countries' dispersions have statistically significant positive relationships with Thailand's dispersion in the previous week. In general, when Thailand's dispersion increased, Indonesia, China, and Brazil's dispersion increased in the following week. This is potentially explained by autocorrelation in time series volatility (Bollerslev, 1986). Equation 3.3.2 does not differentiate between periods in the Thai Crisis and those outside of the crisis. In order to determine if Thailand's dispersion in the previous week had an additional impact on China, Indonesia, and Brazil during the Thai Crisis, we utilize the results from Equation 3.4.2.

ψ_1' and $\psi_2'$are the coefficient estimates from Equation 3.4.2. From Table 5, it can be seen that the Thai Crisis has an additional impact on dispersion in both China and Indonesia, but not in Brazil. Thailand's effect on China's dispersion decreases during the Thai Crisis, as noted by the negative value of ψ_2'. During the Thai Crisis, returns became more volatile, resulting in uncertainty in the directional movements of all Thai stocks and thus increased dispersion. This is because certain stocks went down more than others during the Crisis. Figure 5 in section 4.1.1 shows that China's returns correlation with Thailand during the Thai Crisis was not as high as other Southeast Asian countries, such as Indonesia. This implies that while uncertainty existed in the Thai market, increasing Thai dispersion, the effect would not fully reach the Chinese market. China, then, would not experience such an increase in dispersion.

Thailand's dispersion does not significantly impact Indonesia's dispersion during periods outside of the Thai Crisis, as indicated by the lack of significance of ψ_1'. However, during the crisis, ψ_2' is statistically significant, indicating that Thailand's dispersion from the previous week has a positive relationship with Indonesia's dispersion during the crisis period. Indonesia's stocks may have performed similar to Thailand's, with certain assets losing more value than others, thereby increasing dispersion during the time of the Thai Crisis.

In Brazil, the Thai Crisis has no statistically significant additional impact on dispersion – the estimate for $\psi_2'$is not significant at the 0.05 level. However, Thailand's dispersion does appear to be positively related to Brazil's dispersion for the sample period excluding the Thai Crisis. Because the Thai Crisis effects were stronger for Asian countries compared to South American countries, Brazil's market does not experience the same return volatility[14]. Instead of some stocks falling in value more than others (thus attributing to contagion), Brazil's stocks may not have experienced this increase in dispersion during the Thai Crisis. Therefore, the dispersion in Thailand does not appear to provide additional influence on dispersion in Brazil in the Thai Crisis.

[14] Time series market volatility in Brazil during the crisis was 3.73%, compared to 11.54% and 7.86% in Indonesia and Thailand respectively.

4.2.2 Credit Crisis Dispersion Results

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \theta_{t-1} r_{m,t-1}^2 + \psi_1 \gamma_{j,t-1}^2 + u_{i,t} \tag{3.3.2}$$

$$\gamma_{i,t}^2 = \eta_0' + \theta_t' r_{m,t}^2 + \theta_{t-1}' r_{m,t-1}^2 + \psi_1' \gamma_{j,t-1}^2 + \omega_t' \boldsymbol{I} r_{m,t}^2 + \omega_{t-1}' \boldsymbol{I} r_{m,t-1}^2 + \psi_2' \boldsymbol{I} \gamma_{j,t-1}^2 + u_{i,t}' \tag{3.4.2}$$

We now shift our focus to the Credit Crisis from April 2007 to March 2009. Applying regression Equations 3.3.2 and 3.4.2 once more, we use Thailand and China as regressors[15]. Table 6 displays the same regression statistics as Table 5 but for the Credit Crisis. Again, we see statistical significance in ψ_1 for all three countries. When Thailand's dispersion increases, dispersion in China, Indonesia, and Brazil subsequently increase as well, holding all else constant.

Table 6: Weekly Dispersion Regression with Thailand during Credit Crisis– April 2007 to March 2009

	Panel A		Panel B		
Country	ψ_1	$Adj.R^2$	ψ_1'	ψ_2'	$Adj.R^2$
China	0.1570* (0.0265)	0.3119	0.1530* (0.0268)	0.5026* (0.1115)	0.3295
Indonesia	0.4439* (0.0402)	0.3171	0.4219* (0.0412)	-0.0865 (0.1711)	0.3204
Brazil	0.1733* (0.0206)	0.3198	0.1952* (0.0208)	0.0012 (0.0864)	0.3422

* significant at the .05 level

The Credit Crisis does not result in statistically significant additional impact on the dependent countries' dispersion except for China, where ψ_2' is statistically significant at the 0.05 level. During the Credit Crisis, China's dispersion increases if Thailand's dispersion rose the week before. A possible explanation is the fact that the Credit Crisis originated in the US. China is the largest economy in the set of emerging markets, and has financial ties to the US. The US may have a statistically significant impact on both Thailand and China's dispersion. The seemingly strong relationship between Thailand

[15] The rationales for selecting China and Thailand are stated in the Section 2.1.

and China's dispersion is then attributed to the US. Therefore, US dispersion may be a latent variable that might better explain the dispersion in Thailand and in China (Goldstein, 2009).

Table 7 summarizes the results with China as the explanatory country. In Indonesia and Brazil, an increase in China's dispersion, in general, increases their dispersion as well, as indicated by the significance in ψ_1 from Equation 3.3.2. There is no significant relationship between China's dispersion and that of Thailand.

Table 7: Weekly Dispersion Regression with China during Credit Crisis – April 2007 to March 2009

	Panel A		Panel B		
Country	ψ_1	$Adj. R^2$	ψ_1'	ψ_2'	$Adj. R^2$
Thailand	0.0008 (0.0332)	0.1421	0.4211* (0.0485)	-0.3642* (0.0766)	0.1195
Indonesia	0.3477* (0.0566)	0.2357	0.4020* (0.0593)	-0.2367* (0.0937)	0.4319
Brazil	0.1498* (0.0283)	0.2781	0.1769* (0.0298)	-0.1182* (0.0472)	0.2927

* significant at the .05 level

After adding the indicator variables (Equation 3.4.2), the results change. During periods outside of the Credit Crisis, an increase in China's dispersion is expected to increase dispersion in Thailand, Indonesia, and Brazil. All three estimates are statistically significant at the 0.05 level. However, during the Credit Crisis, China's dispersion level has a negative effect on dispersion in the three countries. This is denoted by the statistically significant negative estimates for ψ_2'. These results from Table 7 imply that while dispersion increased in China during the Credit Crisis, the respective dispersion in Thailand, Indonesia, and Brazil did not increase as much. Again, since the Credit Crisis originated in the US, there may be a latent variable at work (Goldstein, 2009). It would be interesting to see the relationship between US dispersion and the dispersion of the dependent countries.

Because China and Thailand's previous week's dispersion had a positive relationship (as seen in Table 6), one would naturally expect the same result when Thailand's dispersion is regressed with China's dispersion from the week before. However, coefficient for ψ_2' is negative in the case of Thailand in Table 7, however, it is positive in Table 6. After examining Figures 7 and 8 below, we see that it makes sense for ψ_2' to be less than 0. The solid line in each figure represents the regression during the Credit Crisis. When we invert the relationship, we invert the plots as well. While solid line is above the dashed line in Figure 7 (Thailand's dispersion has a greater effect on China's during the Credit Crisis), it is above the dashed line in Figure 8 (China's dispersion has less of an effect on Thailand's during the Credit Crisis).

Figure 7. China Dispersion (Y) v. Thai Dispersion (X)

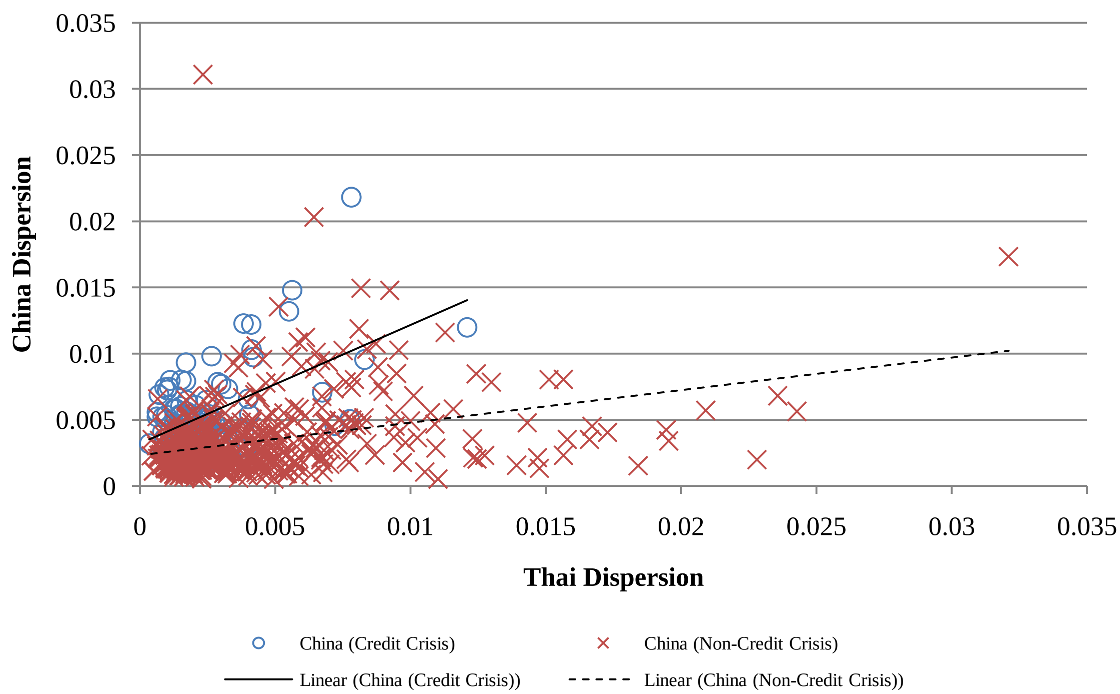
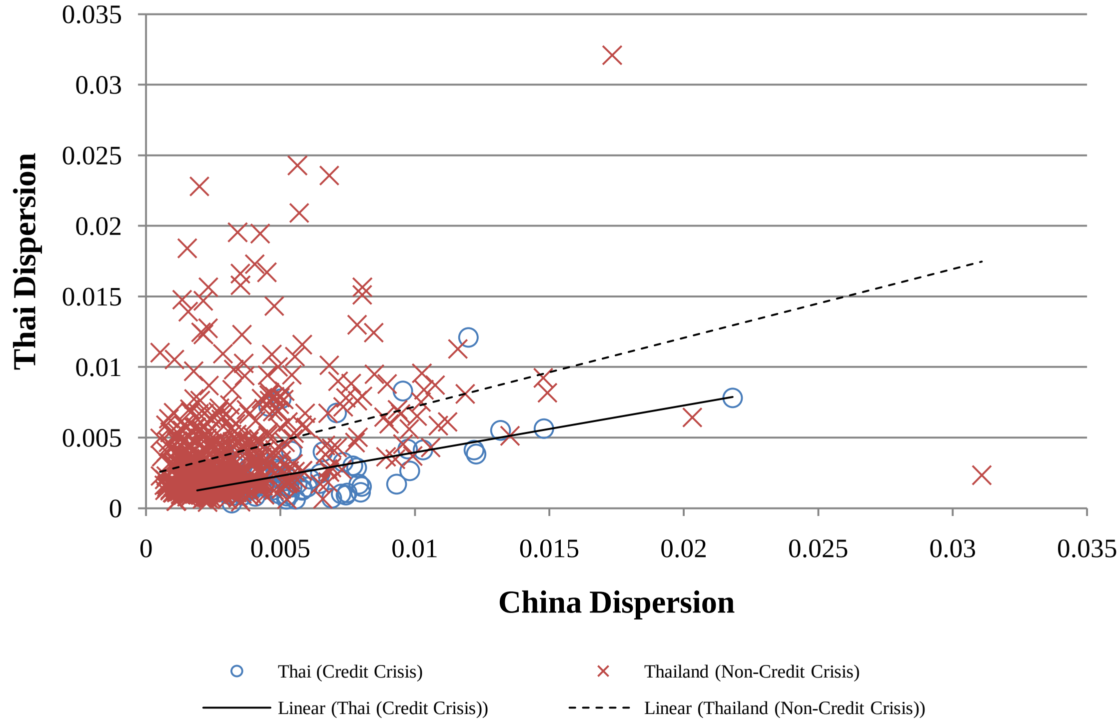


Figure 8. Thai Dispersion (Y) v. China Dispersion (X)



Our regression results indicate contagion in Asian nations during the Thai Crisis. The regression results from the Credit Crisis do not imply the existence of contagion from Thailand or China to other countries. China's impact on the dependent countries' dispersion decreased during the Credit Crisis, and Thailand only significantly impacted China's dispersion. The significant relationship between Thailand's and China's respective dispersion level is potentially explained the presence of a latent variable. Since the Credit Crisis originated in the US, it is possible that US dispersion has a statistically significant relationship with both Thailand and China's dispersion.

5 Conclusion

Our thesis aimed to determine whether emerging equity markets showed evidence of contagion during the Thai Crisis and the Credit Crisis. We derived a multivariate regression model that accounts for both a market effect and the country specific effect of returns (and dispersion), and applied indicator variables to distinguish between periods of a specific crisis from all other periods in the sample.

We found that contagion existed between countries that are geographically close to Thailand during the Thai Crisis. We also saw a positive relationship between the Thai returns and Chinese returns during the Thai Crisis, on the other hand, there existed a negative relationship between Thai returns and Brazil returns during this period. Our results for the regression models during the Credit Crisis did not indicate the existence of contagion among the emerging markets in this period. As previously mentioned, this may be explained by the fact that the Credit Crisis had originated in the United States or the Credit Crisis may be more global than the Thai Crisis.

We found some evidence contagion through analyzing dispersion as well. As with returns, we found that contagion existed during the respective crises in countries in close geographic proximity to the source of the crisis. Indonesia's dispersion had a positive relationship with that of Thailand from the previous week. Additionally, the regression results showed that Thailand's impact on Indonesian dispersion was amplified during the Thai Crisis. Our model did not confirm the existence of contagion during the Credit Crisis. This may be explained by the same reasons as we outlined for returns.

Because the Credit Crisis originated in the US, further investigation is needed on the relationship between US returns and dispersion with those of emerging markets. In our thesis, we established that presence of contagion in the Thai Crisis between Thailand and neighboring Asian countries. We are also interested in a potential "ripple effect," where contagion spreads from the Asian nations affected directly by the Thai Crisis to their neighbors. In the case of the Thai Crisis, our “pandemic” is the devaluation of the Baht in 1997, and we would monitor its spread from Thailand to China, Indonesia, Malaysia, and the Philippines, and from these four nations to their neighbors, and so on. Finally, adjusting the models to account for heteroskedasticity of the data, following Forbes in 2002, could also be an area of future area research. While contagion has yet to be fully characterized, the relationships uncovered shed greater light on market behaviors during times of crisis.

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Appendix A: Complete Country List and Cluster Breakdowns

Countries	EMEA Cluster	South America Cluster	Asia Cluster
Brazil	Morocco	Colombia	Philippines
Chile	Oman	Argentina	Vietnam
China	Mauritius	Venezuela	Laos
Indonesia	Pakistan	Peru	
India	Qatar	Panama	
Korea	Poland		
Mexico	Portugal		
Malaysia	Romania		
Thailand	Russia		
Turkey	Slovenia		
Taiwan	Slovakia		
South Africa	Tunisia		
	Ukraine		
	Latvia		
	Libya		
	Greece		
	Egypt		
	Estonia		
	Czech Republic		
	Cyprus		
	Botswana		
	Bahrain		
	Bulgaria		
	Croatia		
	Hungary		
	Kazakhstan		
	Kuwait		
	Jordan		
	United Arab Emirates		
	Israel		

Appendix B: Full Tables for Returns

I. Regressions without Indicators

$$r_{i,t} = \phi_0 + \lambda_t r_{m,t} + \lambda_{t-1} r_{m,t-1} + \xi_1 r_{j,t-1} + v_{i,t} \quad (3.3.1)$$

Table 8: Weekly Returns Regression with Thailand

Country	λ_t	λ_{t-1}	ξ_1	$Adj. R^2$
Brazil	0.9515*	0.0886	-0.0084	0.4079
	(0.0455)	(0.0570)	(0.0622)	
Chile	1.1640*	-0.0908	-0.0043	0.4848
	(0.0464)	(0.0581)	(0.0635)	
China	1.2502*	-0.0349	0.1165	0.3765
	(0.0633)	(0.0793)	(0.0866)	
Indonesia	0.9342*	0.0726	0.0204	0.4075
	(0.0447)	(0.0561)	(0.0612)	
India	1.5092*	-0.0085	-0.0555	0.5361
	(0.0546)	(0.0684)	(0.0747)	
Korea	0.8034*	0.0392	-0.0791	0.4434
	(0.0351)	(0.0439)	(0.0480)	
Mexico	0.8951*	-0.0131	0.1141*	0.4467
	(0.0396)	(0.0496)	(0.0541)	
Malaysia	1.0113*	0.0166	0.0708	0.4148
	(0.0475)	(0.0595)	(0.0650)	
Turkey	1.0923*	-0.1414	0.1614	0.2317
	(0.0775)	(0.0972)	(0.1061)	
Taiwan	0.9951*	-0.0675	0.0379	0.5323
	(0.0362)	(0.0454)	(0.0496)	
South Africa	0.8423*	-0.0327	-0.0921	0.4272
	(0.0376)	(0.0471)	(0.0515)	
EMEA	0.6352*	0.0381	-0.0810*	0.5172
	(0.0239)	(0.0300)	(0.0327)	
S.Amer	0.6451*	0.0132	0.0201	0.4416
	(0.0285)	(0.0357)	(0.0390)	
Asia	0.9622*	-0.0081	0.0392	0.4297
	(0.0434)	(0.0544)	(0.0594)	

* significant at the .05 level

Table 9: Weekly Returns Regression with China

Country	λ_t	λ_{t-1}	ξ_1	$Adj. R^2$
Brazil	0.9563*	0.0173	0.0572	0.4099
	(0.0455)	(0.0632)	(0.0379)	
Thailand	1.0087*	0.1209	-0.0560	0.4155
	(0.0475)	(0.0661)	(0.0396)	
Chile	0.5445*	0.0820*	0.0058	0.3803
	(0.0281)	(0.0391)	(0.0234)	
Indonesia	1.2487*	0.0978	-0.0587	0.3760
	(0.0634)	(0.0882)	(0.0528)	
India	0.9358*	0.0715	0.0107	0.4075
	(0.0448)	(0.0623)	(0.0373)	
Korea	1.5099*	-0.0722	0.0284	0.5359
	(0.0547)	(0.0760)	(0.0455)	
Mexico	0.8042*	-0.0477	0.0371	0.4425
	(0.0352)	(0.0489)	(0.0293)	
Malaysia	0.8972*	0.0691	-0.0165	0.4432
	(0.0398)	(0.0553)	(0.0331)	
Turkey	1.0953*	-0.0267	-0.0219	0.2291
	(0.0778)	(0.1082)	(0.0648)	
Taiwan	0.9967*	-0.0512	0.0041	0.5319
	(0.0363)	(0.0505)	(0.0302)	
South Africa	0.8439*	-0.1423*	0.0504	0.4267
	(0.0377)	(0.0524)	(0.0314)	
EMEA	0.6322*	0.0003	-0.0060	0.5129
	(0.0241)	(0.0335)	(0.0200)	
S.Amer	0.6470*	0.0071	0.0148	0.4417
	(0.0286)	(0.0397)	(0.0238)	
Asia	0.9585*	0.0788	-0.0560	0.4314
	(0.0434)	(0.0604)	(0.0361)	

* significant at the .05 level

Table 10: Weekly Returns Regression with Brazil

Country	λ_t	λ_{t-1}	ξ_1	$Adj.R^2$
Thailand	1.0091*	0.0221	0.0356	0.4144
	(0.0477)	(0.0610)	(0.0405)	
Chile	0.5400*	0.0583	0.0322	0.3819
	(0.0282)	(0.0360)	(0.0240)	
China	1.1624*	-0.1047	0.0122	0.4849
	(0.0466)	(0.0596)	(0.0396)	
Indonesia	1.2389*	-0.0830	0.1191*	0.3794
	(0.0634)	(0.0811)	(0.0539)	
India	0.9352*	0.0867	-0.0030	0.4074
	(0.0450)	(0.0575)	(0.0382)	
Korea	1.5141*	0.0108	-0.0529	0.5366
	(0.0548)	(0.0700)	(0.0465)	
Mexico	0.8037*	0.0160)	-0.0217	0.4416
	(0.0353)	(0.0451)	(0.0300)	
Malaysia	0.9041*	0.0915	-0.0440	0.4444
	(0.0398)	(0.0509)	(0.0338)	
Turkey	1.0827*	-0.1623	0.1165	0.2326
	(0.0779)	(0.0995)	(0.0661)	
Taiwan	0.9849*	-0.1327*	0.0912*	0.5380
	(0.0362)	(0.0463)	(0.0307)	
South Africa	0.8515*	0.0077	-0.0966*	0.4322
	(0.0376)	(0.0481)	(0.0320)	
EMEA	0.6320*	-0.0118	0.0055	0.5129
	(0.0241)	(0.0309)	(0.0205)	
S.Amer	0.6457*	0.0246	-0.0003	0.4414
	(0.0287)	(0.0366)	(0.0243)	
Asia	0.9626*	0.0074	0.0065	0.4294
	(0.0436)	(0.0558)	(0.0371)	

* significant at the .05 level

II. Regressions with Indicators

$$r_{i,t} = \phi_0' + \lambda_t' r_{m,t} + \lambda_{t-1}' r_{m,t-1} + \xi_1' r_{j,t-1} + \tau_t' \boldsymbol{I} r_{m,t} + \tau_{t-1}' \boldsymbol{I} r_{m,t-1} + \xi_2' I r_{j,t-1} + v_{i,t}' \quad (3.4.1)$$

Table 11: Weekly Returns Regression with Thailand during Thai Crisis

Country	λ_t'	τ_t'	λ_{t-1}'	τ_{t-1}'	ξ_1'	ξ_2'	$Adj. R^2$
Brazil	1.0937*	-0.5830*	0.0032	0.4752*	0.0204	-0.1851*	0.4397
	(0.0502)	(0.1095)	(0.0623)	(0.1698)	(0.0415)	(0.0925)	
Chile	0.5904*	-0.1556*	0.0732	0.3493*	-0.0370	-0.0844	0.3983
	(0.0314)	(0.0685)	(0.0390)	(0.1063)	(0.0259)	(0.0579)	
China	0.9960*	0.6579*	0.0321	-0.7666*	-0.0230	0.2581*	0.5275
	(0.0504)	(0.1100)	(0.0625)	(0.1706)	(0.0416)	(0.0929)	
Indonesia	1.0352*	0.9051*	0.1046	-0.6200*	0.0116	0.2275	0.4150
	(0.0695)	(0.1517)	(0.0863)	(0.2353)	(0.0574)	(0.1281)	
India	1.1114*	-0.7679*	-0.0471	0.3539*	0.0714	-0.1245	0.4561
	(0.0486)	(0.1061)	(0.0603)	(0.1646)	(0.0402)	(0.0896)	
Korea	1.4680*	0.1115	-0.0603	-0.3824	0.0400	0.2063	0.5394
	(0.0617)	(0.1346)	(0.0765)	(0.2088)	(0.0510)	(0.1137)	
Mexico	0.8484*	-0.1504	-0.0270	0.4136*	-0.0076	-0.1976*	0.4528
	(0.0394)	(0.0861)	(0.0489)	(0.1335)	(0.0326)	(0.0727)	
Malaysia	0.6539*	1.0250*	0.1185*	-0.6059*	-0.0228	0.3556*	0.5695
	(0.0396)	(0.0864)	(0.0491)	(0.1340)	(0.0327)	(0.0730)	
Turkey	1.2681*	-0.6583*	-0.1015	0.7631*	-0.0014	-0.4131*	0.2545
	(0.0867)	(0.1891)	(0.1075)	(0.2932)	(0.0716)	(0.1597)	
Taiwan	1.0773*	-0.3704*	-0.0202	-0.0384	0.0088	-0.1148	0.5509
	(0.0403)	(0.0879)	(0.0500)	(0.1364)	(0.0333)	(0.0743)	
South Africa	0.8605*	-0.0454	-0.1435*	0.3626*	0.0036	-0.0744	0.4296
	(0.0426)	(0.0929)	(0.0529)	(0.1442)	(0.0352)	(0.0785)	
EMEA	0.6575*	-0.0875	0.0228	0.1220	-0.0307	-0.0840	0.5199
	(0.0271)	(0.0591)	(0.0336)	(0.0916)	(0.0224)	(0.0499)	
S.Amer	0.7001*	-0.2072*	-0.0121	0.2774*	0.0144	-0.1373*	0.4544
	(0.0320)	(0.0698)	(0.0397)	(0.1082)	(0.0264)	(0.0589)	
Asia	0.7910*	0.7812*	-0.0304	0.0156	0.0651	-0.0112	0.4787
	(0.0471)	(0.1027)	(0.0584)	(0.1593)	(0.0389)	(0.0867)	

* significant at the .05 level

Table 12: Weekly Returns Regression with Thailand during Credit Crisis

Country	λ'_t	τ'_t	λ'_{t-1}	τ'_{t-1}	ξ'_1	ξ'_2	$Adj.R^2$
Brazil	0.8653*	0.2580*	0.1536*	-0.1128*	-0.0219	-0.0209	0.4129
	(0.0554)	(0.0961)	(0.0704)	(0.1529)	(0.0386)	(0.1440)	
Chile	0.5024*	0.1312*	0.1935*	-0.2605*	-0.0590*	0.1646	0.3916
	(0.0341)	(0.0591)	(0.0433)	(0.0940)	(0.0238)	(0.0886)	
China	1.1769*	-0.0396	-0.1977*	0.2927	0.0411	-0.1303	0.4861
	(0.0567)	(0.0984)	(0.0721)	(0.1565)	(0.0395)	(0.1474)	
Indonesia	1.2677*	-0.0556	-0.0439	0.1366	0.0781	-0.1975	0.3747
	(0.0775)	(0.1345)	(0.0986)	(0.2140)	(0.0541)	(0.2016)	
India	0.7769*	0.4740*	0.0814	-0.1302	0.0332	0.0769	0.4279
	(0.0538)	(0.0933)	(0.0684)	(0.1485)	(0.0375)	(0.1399)	
Korea	1.6099*	-0.3161*	-0.2210*	0.3581	0.0975*	-0.1557	0.5436
	(0.0662)	(0.1149)	(0.0842)	(0.1828)	(0.0462)	(0.1722)	
Mexico	0.7340*	0.2064*	0.0327	0.0511	-0.0359	-0.0520	0.4474
	(0.0427)	(0.0742)	(0.0543)	(0.1180)	(0.0298)	(0.1111)	
Malaysia	1.0106*	-0.3481*	-0.0377	0.0554	0.0744*	-0.0487	0.4596
	(0.0478)	(0.0830)	(0.0608)	(0.1321)	(0.0334)	(0.1244)	
Turkey	1.0287*	0.2188	0.1408	-0.4080	-0.1202	0.2568	0.2327
	(0.0948)	(0.1645)	(0.1205)	(0.2617)	(0.0661)	(0.2465	
Taiwan	1.0374*	-0.1152	0.0352	-0.2417*	-0.0626*	0.2255)	0.5360
	(0.0442)	(0.0767)	(0.0562)	(0.1219)	(0.0308)	(0.1148)	
South Africa	0.7817*	0.1713*	-0.0689	-0.0282	0.0080	-0.0394	0.4262
	(0.0461)	(0.0800)	(0.0586)	(0.1272)	(0.0321)	(0.1198)	
EMEA	0.5852*	0.1481*	0.0341	0.0670	-0.0427*	-0.0631	0.5225
	(0.0291)	(0.0505)	(0.0370)	(0.0804)	(0.0203)	(0.0757)	
S.Amer	0.5278*	0.3541*	0.0892*	-0.1249	-0.0147	-0.0090	0.4700
	(0.0340)	(0.0590)	(0.0432)	(0.0938)	(0.0237)	(0.0884)	
Asia	0.9914*	-0.1017	-0.0593	0.0621	0.0941*	-0.1715	0.4352
	(0.0528)	(0.0917)	(0.0672)	(0.1459)	(0.0369)	(0.1374)	

* significant at the .05 level

Table 13: Weekly Dispersion Regression with China during Credit Crisis

Country	λ'_t	τ'_t	λ'_{t-1}	τ'_{t-1}	ξ'_1	ξ'_2	$Adj.R^2$
Brazil	0.8689*	0.2570*	0.0887	-0.3745*	0.0341	0.2233	0.4165
	(0.0554)	(0.0959)	(0.0720)	(0.1843)	(0.0393)	(0.1382)	
Thailand	1.1265*	-0.3517*	0.0741	0.1015	-0.0488	-0.0038	0.3916
	(0.0578)	(0.1001)	(0.0751)	(0.1923)	(0.0410)	(0.1443)	
Chile	0.4983*	0.1351*	0.1262*	-0.1387	0.0008	0.0259	0.4861
	(0.0344)	(0.0595)	(0.0447)	(0.1143)	(0.0244)	(0.0858)	
Indonesia	1.2677*	-0.0572	0.0914	0.2006	-0.0402	-0.2196	0.3747
	(0.0777)	(0.1347)	(0.1011)	(0.2587)	(0.0552)	(0.1941)	
India	0.7791*	0.4699*	0.1124	-0.0240	0.0056	-0.0494	0.4279
	(0.0540)	(0.0935)	(0.0702)	(0.1797)	(0.0383)	(0.1348)	
Korea	1.6211*	-0.3277*	-0.1541	0.2198	0.0364	-0.0156	0.5436
	(0.0666)	(0.1154)	(0.0866)	(0.2216)	(0.0473)	(0.1663)	
Mexico	0.7374*	0.2036*	-0.0581	0.1551	0.0427	-0.1159	0.4474
	(0.0429)	(0.0742)	(0.0557)	(0.1426)	(0.0304)	(0.1070)	
Malaysia	1.0152*	-0.3549*	0.0444	0.1535	0.0016	-0.1427	0.4596
	(0.0481)	(0.0833)	(0.0625)	(0.1601)	(0.0341)	(0.1201)	
Turkey	1.0157*	0.2326	0.0500	-0.3213	-0.0379	0.1387	0.2327
	(0.0953)	(0.1651)	(0.12390	(0.3171)	(0.0676)	(0.2379)	
Taiwan	1.0342*	-0.1137	-0.0519	0.0752	0.0142	-0.1016	0.5360
	(0.0445)	(0.0770)	(0.0578)	(0.1480)	(0.0316)	(0.1110)	
South Africa	0.7877*	0.1662*	-0.1080	-0.1504	0.0408	0.0787	0.4262
	(0.0461)	(0.0799)	(0.0600)	(0.1534)	(0.0327)	(0.1151)	
EMEA	0.5815*	0.1535*	-0.0009	-0.0047	-0.0113	0.0313	0.5225
	(0.0293)	(0.0508)	(0.0381)	(0.0976)	(0.0208)	(0.0732)	
S.Amer	0.5269*	0.3563*	0.0750	-0.2638*	-0.0020	0.1203	0.4700
	(0.0340)	(0.0590)	(0.0443)	(0.1133)	(0.0242)	(0.0850)	
Asia	0.9907*	-0.1013	0.1127	-0.1311	-0.0561	0.0198	0.4352
	(0.0532)	(0.0921)	(0.0691)	(0.1769)	(0.0377)	(0.1327)	

* significant at the .05 level

Table 14: Weekly Returns Regression with Brazil during Credit Crisis

Country	λ'_t	τ'_t	λ'_{t-1}	τ'_{t-1}	ξ'_1	ξ'_2	$Adj. R^2$
Thailand	1.1259*	-0.3476*	-0.0183	0.1970	0.0407	-0.0977	0.4234
	(0.0580)	(0.1005)	(0.0685)	(0.1664)	(0.0432)	(0.1228)	
Chile	0.4922*	0.1383*	0.0943*	-0.1200	0.0382	0.0008	0.3869
	(0.0344)	(0.0596)	(0.0406)	(0.0987)	(0.0256)	(0.0728)	
China	1.1788*	-0.0406	-0.1573*	0.1902	0.0067	-0.0153	0.4850
	(0.0571)	(0.0990)	(0.0674)	(0.1638)	(0.0425)	(0.1209)	
Indonesia	1.2577*	-0.0616	-0.0455	-0.2331	0.1040	0.1432	0.3778
	(0.0778)	(0.1348)	(0.0919)	(0.2231)	(0.0579)	(0.1647)	
India	0.7779*	0.4709*	0.1154	-0.0869	0.0041	0.0049	0.4267
	(0.0542)	(0.0939)	(0.0640)	(0.1554)	(0.0404)	(0.1147)	
Korea	1.6214*	-0.3116*	-0.0785	0.4514*	-0.0379	-0.2168	0.5434
	(0.0666)	(0.1155)	(0.0787)	(0.1911)	(0.0496)	(0.1411)	
Mexico	0.7360*	0.2055*	0.0130	-0.0033	-0.0243	0.0284	0.4461
	(0.0431)	(0.0746)	(0.0509)	(0.1235)	(0.0321)	(0.0912)	
Malaysia	1.0254*	-0.3668*	0.0989	-0.1167	-0.0613	0.1113	0.4582
	(0.0482)	(0.0835)	(0.0569)	(0.1383)	(0.0359)	(0.1021)	
Turkey	1.0008*	0.2372	-0.1023	-0.2055	0.1253	0.0099	0.2327
	(0.0954)	(0.1653)	(0.1127)	(0.2736)	(0.0710)	(0.2020)	
Taiwan	1.0211*	-0.1134	-0.1014	-0.2023	0.0770*	0.1278	0.5392
	(0.0443)	(0.0768)	(0.0523)	(0.1270)	(0.0330)	(0.0938)	
South Africa	0.7958*	0.1666*	0.0152	0.0141	-0.0875*	-0.0487	0.4335
	(0.0461)	(0.0798)	(0.0544	(0.1321)	(0.0343)	(0.0975)	
EMEA	0.5819*	0.1529*	-0.0197	0.0357	0.0064	-0.0055	0.5178
	(0.0294)	(0.0510)	(0.0348)	(0.0844)	(0.0219)	(0.0623)	
S.Amer	0.5240*	0.3615*	0.0583	-0.0554	0.0167	-0.0684	0.4704
	(0.0342)	(0.0592)	(0.0404)	(0.0980)	(0.0255)	(0.0724)	
Asia	0.9980*	-0.1130	0.0455	-0.1842	0.0013	0.0694	0.4298
	(0.0534)	(0.0926)	(0.0631)	(0.1532)	(0.0398)	(0.1131)	

* significant at the .05 level

Table 15: Weekly Returns Regression with Brazil during Brazil Elections

Country	λ'_t	τ'_t	λ'_{t-1}	τ'_{t-1}	ξ'_1	ξ'_2	$Adj.R^2$
Thailand	1.0092*	0.0656	0.0190	-0.0993	0.0469	-0.1556	0.4133
	(0.0484)	(0.3129)	(0.0624)	(0.3328)	(0.0421)	(0.1754)	
Chile	0.5455*	-0.1649	0.0585	-0.1649	0.0398	-0.0560	0.3833
	(0.0285)	(0.1845)	(0.0368)	(0.1962)	(0.0248)	(0.1034)	
China	1.1866*	-0.9205*	-0.1137	0.0823	0.0216	0.0529	0.4904
	(0.0470)	(0.3037)	(0.0605)	(0.3230)	(0.0409)	(0.1703)	
Indonesia	1.2512*	-0.3890	-0.1167	0.7314	0.1440*	-0.3046	0.3811
	(0.0642)	(0.4149)	(0.0827)	(0.4413)	(0.0558)	(0.2326)	
India	0.9526*	-0.6649*	0.0924	-0.3000	-0.0008	0.1248	0.4106
	(0.0454)	(0.2937)	(0.0586)	(0.3124)	(0.0395)	(0.1647)	
Korea	1.5043*	0.3328	0.0212	-0.1387	-0.0643	0.0952	0.5357
	(0.0556)	(0.3593)	(0.0716)	(0.3822)	(0.0483)	(0.2015)	
Mexico	0.8000*	0.1662	0.0138	0.0292	-0.0183	-0.0798	0.4397
	(0.0358)	(0.2316)	(0.0462)	(0.2463)	(0.0312)	(0.1298)	
Malaysia	0.9099*	-0.1675	0.0832	0.0672	-0.0322	-0.1281	0.4438
	(0.0404)	(0.2612)	(0.0521)	(0.2778)	(0.0351)	(0.1464)	
Turkey	1.1185*	-1.3235*	-0.1883	0.4160	0.1397*	-0.0742	0.2392
	(0.0786)	(0.5079)	(0.1012)	(0.5402)	(0.0683)	(0.2847)	
Taiwan	0.9663*	0.7127*	-0.1303*	0.0532	0.0865*	-0.0835	0.5427
	(0.0365)	(0.2359)	(0.0470)	(0.2509)	(0.0317)	(0.1323)	
South Africa	0.8648*	-0.5548*	0.0173	-0.2645	-0.1034*	0.2198	0.4349
	(0.0381)	(0.2460)	(0.0490)	(0.2617)	(0.0331)	(0.1379)	
EMEA	0.6408*	-0.3471*	-0.0140	0.0325	0.0066	0.0527	0.5143
	(0.0244)	(0.1580)	(0.0315)	(0.1680)	(0.0213)	(0.0886)	
S.Amer	0.6566*	-0.4059*	0.0210	0.0109	0.0044	0.0175	0.4435
	(0.0290)	(0.1874)	(0.0374)	(0.1993)	(0.0252)	(0.1051)	
Asia	0.9832*	-0.8458*	0.0112	-0.1104	0.0018	0.2388	0.4344
	(0.0440)	(0.2845)	(0.0567)	(0.3026)	(0.0383)	(0.1595)	

* significant at the .05 level

Appendix C: Full Tables for Dispersion

I. Regressions without Indicators

$$\gamma_{i,t}^2 = \eta_0 + \theta_t r_{m,t}^2 + \theta_{t-1} r_{m,t-1}^2 + \psi_1 \gamma_{j,t-1}^2 + u_{i,t} \tag{3.3.2}$$

Table 16: Weekly Dispersion Regression with Thailand

Country	θ_t	θ_{t-1}	ψ_1	$Adj. R^2$
Brazil	0.2621* (0.0347)	0.2738* (0.0354)	0.1733* (0.0206)	0.3198
Chile	0.0732* (0.0207)	0.0668* (0.0212)	0.0780* (0.0123)	0.1204
China	0.3172* (0.0446)	0.4287* (0.0455)	0.1570* (0.0265)	0.3120
Indonesia	0.3787* (0.0676)	0.4797* (0.0691)	0.4439* (0.0402)	0.3171
India	0.1756* (0.0538)	0.1663* (0.0550)	0.0479 (0.0320)	0.0508
Korea	0.2004* (0.0748)	0.1695* (0.0764)	0.2860* (0.0445)	0.0968
Mexico	0.2215* (0.0328)	0.2960* (0.0335)	0.0549* (0.0195)	0.2536
Malaysia	0.2285* (0.0342)	0.2056* (0.0350)	0.2781* (0.0203)	0.3663
Turkey	0.1395* (0.0480)	0.1169* (0.0491)	0.2077* (0.0285)	0.1182
Taiwan	0.1058* (0.0308)	0.1434* (0.0314)	0.0077 (0.0183)	0.0730
South Africa	0.1833* (0.0346)	0.1668* (0.0354)	0.1523* (0.0206)	0.1978
EMEA	0.2820* (0.0368)	0.2458* (0.0376)	0.0432* (0.0219)	0.2117
Asia	0.2430* (0.0489)	0.1810* (0.0500)	0.3376* (0.0291)	0.2597
S.Amer	0.2280* (0.0419)	0.3056* (0.0429)	0.0204 (0.0249)	0.1682

* significant at the .05 level

Table 17: Weekly Dispersion Regression with China

Country	θ_t	θ_{t-1}	ψ_1	$Adj. R^2$
Brazil	0.2383*	0.2695*	0.1498*	0.2782
	(0.0361)	(0.0378)	(0.0283)	
Thailand	0.1769*	0.1709*	0.3356*	0.1422
	(0.0624)	(0.0654)	(0.0489)	
Chile	0.0626*	0.0651*	0.0668*	0.0895
	(0.0213)	(0.0223)	(0.0167)	
Indonesia	0.3241*	0.4844*	0.3477*	0.2357
	(0.0723)	(0.0758)	(0.0566)	
India	0.1380*	0.0889	0.2147*	0.0838
	(0.0534)	(0.0559)	(0.0418)	
Korea	0.1938*	0.2427*	0.0644	0.0425
	(0.0778)	(0.0815)	(0.0609)	
Mexico	0.2049*	0.2724*	0.0980*	0.2607
	(0.0330)	(0.0346)	(0.0259)	
Malaysia	0.2032*	0.2303*	0.1684*	0.2257
	(0.0382)	(0.0400)	(0.0299)	
Turkey	0.1204*	0.1350*	0.1265*	0.0629
	(0.0500)	(0.0524)	(0.0392)	
Taiwan	0.0961*	0.1221*	0.0547*	0.0798
	(0.0310)	(0.0325)	(0.0243)	
South Africa	0.1632*	0.1649*	0.1271*	0.1579
	(0.0358)	(0.0375)	(0.0281)	
EMEA	0.2553*	0.1938*	0.1532*	0.2398
	(0.0365)	(0.0383)	(0.0286)	
Asia	0.2090*	0.2031*	0.2222*	0.1471
	(0.0531)	(0.0556)	(0.0416)	
S.Amer	0.2282*	0.3124*	0.0008	0.1674
	(0.0424)	(0.0444)	(0.0332)	

* significant at the .05 level

Table 18: Weekly Dispersion Regression with Brazil

Country	θ_t	θ_{t-1}	ψ_1	$Adj.R^2$
Thailand	0.1714*	0.1700*	0.4396*	0.1452
	(0.0623)	(0.0651)	(0.0623)	
Chile	0.0441*	0.0258	0.2036*	0.1917
	(0.0201)	(0.0210)	(0.0201)	
China	0.2917*	0.4204*	0.1896*	0.2940
	(0.0456)	(0.0477)	(0.0457)	
Indonesia	0.3093*	0.4627*	0.5170*	0.2510
	(0.0716)	(0.0749)	(0.0717)	
India	0.1389*	0.0984	0.2514*	0.0780
	(0.0536)	(0.0560)	(0.0536)	
Korea	0.1281	0.0962	0.5176*	0.1042
	(0.0753)	(0.0787)	(0.0753)	
Mexico	0.1806*	0.2207*	0.2806*	0.3245
	(0.0316)	(0.0330)	(0.0316)	
Malaysia	0.2076*	0.2461*	0.1726*	0.2126
	(0.0386)	(0.0403)	(0.0386)	
Turkey	0.0998*	0.0926	0.2904*	0.0955
	(0.0492)	(0.0514)	(0.0492)	
Taiwan	0.0846*	0.0978*	0.1432*	0.1021
	(0.0306)	(0.0320)	(0.0306)	
South Africa	0.1372*	0.1104*	0.3270*	0.2369
	(0.0341)	(0.0357)	(0.0341)	
EMEA	0.2450*	0.1757*	0.2530*	0.2616
	(0.0360)	(0.0376)	(0.0360)	
Asia	0.2078*	0.2080*	0.2750*	0.1448
	(0.0532)	(0.0556)	(0.0532)	
S.Amer	0.1990*	0.2465*	0.1964*	0.1941
	(0.0417)	(0.0436)	(0.0418)	

* significant at the .05 level

II. Regressions with Indicators

$$\gamma_{i,t}^2 = \eta_0' + \theta_t' r_{m,t}^2 + \theta_{t-1}' r_{m,t-1}^2 + \psi_1' \gamma_{j,t-1}^2 + \omega_t' \boldsymbol{I} r_{m,t}^2 + \omega_{t-1}' \boldsymbol{I} r_{m,t-1}^2 + \psi_2' \boldsymbol{I} \gamma_{j,t-1}^2 + u_{i,t}' \quad (3.4.2)$$

Table 19: Weekly Dispersion Regression with Thailand during Thai Crisis

Country	θ_t'	ω_t'	θ_{t-1}'	ω_{t-1}'	ψ_1'	ψ_2'	$Adj. R^2$
Brazil	0.2805*	-0.1450	0.3100*	-0.2733*	0.1814*	0.0390	0.3320
	(0.0380)	(0.0877)	(0.0388)	(0.0941)	(0.0353)	(0.0379)	
Chile	0.0637*	0.0538	0.0763*	-0.0608	0.1011*	-0.0251	0.1213
	(0.0230)	(0.0529)	(0.0234)	(0.0568)	(0.0213)	(0.0229)	
China	0.3045*	0.1837	0.3528*	0.4815*	0.2374*	-0.1721*	0.3344
	(0.0485)	(0.1119)	(0.0495)	(0.1202)	(0.0450)	(0.0484)	
Indonesia	0.3382*	0.2020	0.4063*	0.7311*	0.1036	0.2881*	0.3824
	(0.0712)	(0.1643)	(0.0727)	(0.1764)	(0.0661)	(0.0710)	
India	0.2427*	-0.2821*	0.1568*	-0.2039	0.3562*	-0.3074*	0.1351
	(0.0569)	(0.1311)	(0.0580)	(0.1408)	(0.0528)	(0.0566)	
Korea	0.2103*	-0.0406	0.1462	0.1492	0.2671	0.0080	0.0937
	(0.0830)	(0.1913)	(0.0846)	(0.2053)	(0.0770)	(0.0826)	
Mexico	0.2151*	0.0284	0.3069*	-0.0667	0.0615	-0.0024	0.2510
	(0.0364)	(0.0840)	(0.0372)	(0.0902)	(0.0338)	(0.0363)	
Malaysia	0.1729*	0.3674*	0.1194*	0.7421*	0.1205*	0.0560	0.5107
	(0.0333)	(0.0768)	(0.0340)	(0.0824)	(0.0309)	(0.0332)	
Turkey	0.1251*	0.1193	0.0974	0.1315	0.2463*	-0.0735	0.1183
	(0.0532)	(0.1226)	(0.0542)	(0.1316)	(0.0493)	(0.0530)	
Taiwan	0.1270*	-0.1090	0.1540*	-0.1464	0.0895*	-0.0668*	0.0962
	(0.0336)	(0.0776)	(0.0343)	(0.0833)	(0.0312)	(0.0335)	
South Africa	0.1431*	0.2508*	0.1364*	0.2946*	0.0939*	0.0066	0.2319
	(0.0375)	(0.0865)	(0.0383)	(0.0928)	(0.0348)	(0.0374)	
EMEA	0.2999*	-0.0860	0.2639*	-0.2088*	0.1582*	-0.1002*	0.2366
	(0.0401)	(0.0925)	(0.0409)	(0.0993)	(0.0372)	(0.0400)	
Asia	0.1518*	0.4643*	0.1881*	0.1990	0.1380*	0.1620*	0.3127
	(0.0522)	(0.1204)	(0.0533)	(0.1293)	(0.0484)	(0.0520)	
S.Amer	0.2471*	-0.1389	0.3369*	-0.2499*	0.0435	0.0178	0.1764
	(0.0462)	(0.1066)	(0.0471)	(0.1144)	(0.0429)	(0.0460)	

* significant at the .05 level

Table 20: Weekly Dispersion Regression with Thailand during Credit Crisis

Country	θ'_t	ω'_t	θ'_{t-1}	ω'_{t-1}	ψ'_1	ψ'_2	$Adj.R^2$
Brazil	0.2438*	-0.0307	0.0688	0.3318*	0.1952*	0.0012	0.3422
	(0.0518)	(0.0697)	(0.0538)	(0.0756)	(0.0208)	(0.0864)	
Chile	0.0768*	-0.0196	0.0331	0.0493	0.0813*	0.0268	0.1195
	(0.0315)	(0.0424)	(0.0328)	(0.0460)	(0.0127)	(0.0526)	
China	0.3668*	-0.1377	0.4619*	-0.1805	0.1530*	0.5026*	0.3295
	(0.0669)	(0.0899)	(0.0695)	(0.0976)	(0.0268)	(0.1115)	
Indonesia	0.4672*	-0.0913	0.6422*	-0.2146	0.4219*	-0.0865	0.3204
	(0.1026)	(0.1380)	(0.1066)	(0.1497)	(0.0412)	(0.1711)	
India	0.0849	0.1026	0.0433	0.1388	0.0662*	0.1220	0.0574
	(0.0815)	(0.1096)	(0.0847)	(0.1189)	(0.0327)	(0.1359)	
Korea	0.4103*	-0.2943	0.3050*	-0.1027	0.2592*	-0.1851	0.1071
	(0.1130)	(0.1520)	(0.1175)	(0.1650)	(0.0454)	(0.1885)	
Mexico	0.2765*	-0.1155	0.2460*	0.0857	0.0570*	0.0517	0.2549
	(0.0499)	(0.0671)	(0.0518)	(0.0728)	(0.0200)	(0.0832)	
Malaysia	0.4435*	-0.2957*	0.4619*	-0.3658*	0.2398*	0.0470	0.4301
	(0.0493)	(0.0664)	(0.0513)	(0.0720)	(0.0198)	(0.0823)	
Turkey	0.1996*	-0.0838	0.0527	0.2112*	0.2094*	-0.3037*	0.1258
	(0.0727)	(0.0977)	(0.0755)	(0.1061)	(0.0292)	(0.1212)	
Taiwan	0.1133*	-0.0210	0.1305*	0.0143	0.0087	0.0335	0.0693
	(0.0469)	(0.0630)	(0.0487)	(0.0684)	(0.0188)	(0.0782)	
South Africa	0.2597*	-0.1281	0.2085*	-0.0670	0.1440*	0.0820	0.2003
	(0.0525)	(0.0706)	(0.0546)	(0.0767)	(0.0211)	(0.0876)	
EMEA	0.2947*	-0.1002	0.1439*	0.0646	0.0545*	0.3806*	0.2378
	(0.0550)	(0.0740)	(0.0572)	(0.0803)	(0.0221)	(0.0917)	
Asia	0.3847*	-0.2071*	0.2783*	-0.1014	0.3192*	-0.0452	0.2675
	(0.0740)	(0.0995)	(0.0769)	(0.1080)	(0.0297)	(0.1234)	
S.Amer	0.2159*	0.0179	0.2315*	0.1621	0.0279	-0.1558	0.1692
	(0.0637)	(0.0857)	(0.0662)	(0.0930)	(0.0256)	(0.1063)	

* significant at the .05 level

Table 21: Weekly Dispersion Regression with China during Credit Crisis

Country	θ'_t	ω'_t	θ'_{t-1}	ω'_{t-1}	ψ'_1	ψ'_2	$Adj.R^2$
Brazil	0.2452*	-0.0299	0.1128*	0.3090*	0.1769*	-0.1182*	0.2927
	(0.0539)	(0.0730)	(0.0560)	(0.0775)	(0.0298)	(0.0472)	
Thailand	0.5068*	-0.3631*	0.5118*	-0.3681*	0.4211*	-0.3642*	0.1195
	(0.0876)	(0.1185)	(0.0909)	(0.1258)	(0.0485)	(0.0766)	
Chile	0.0776*	-0.0211	0.0515	0.0390	0.0748*	-0.0343	0.3295
	(0.0322)	(0.0436)	(0.0334)	(0.0463)	(0.0178)	(0.0282)	
Indonesia	0.4747*	-0.1176	0.7366*	-0.3092*	0.4020*	-0.2367*	0.3204
	(0.1072)	(0.1451)	(0.1112)	(0.1540)	(0.0593)	(0.0937)	
India	0.0481	0.1382	-0.0346	0.2158	0.2334*	-0.0898	0.0574
	(0.0805)	(0.1089)	(0.0835)	(0.1156)	(0.0445)	(0.0703)	
Korea	0.4357*	-0.3065	0.4262*	-0.1823	0.1104	-0.1902	0.1071
	(0.1159)	(0.1568)	(0.1202)	(0.1664)	(0.0641)	(0.1013)	
Mexico	0.2644*	-0.1032	0.2278*	0.1085	0.1098*	-0.0472	0.2549
	(0.0498)	(0.0674)	(0.0517)	(0.0715)	(0.0275)	(0.0435)	
Malaysia	0.4577*	-0.3223*	0.5396*	-0.4364*	0.1855*	-0.0618	0.4301
	(0.0532)	(0.0719)	(0.0551)	(0.0763)	(0.0294)	(0.0465)	
Turkey	0.1972*	-0.0692	0.0943	0.1873	0.1921*	-0.2880*	0.0693
	(0.0743)	(0.1006)	(0.0771)	(0.1068)	(0.0411)	(0.0650)	
Taiwan	0.1062*	-0.0217	0.1108*	0.0207	0.0541*	0.0038	0.2003
	(0.0469)	(0.0635)	(0.0486)	(0.0673)	(0.0259)	(0.0410)	
South Africa	0.2615*	-0.1347	0.2401*	-0.0883	0.1370*	-0.0379	0.2378
	(0.0537)	(0.0727)	(0.0557)	(0.0772)	(0.0297)	(0.0470)	
EMEA	0.2744*	-0.0769	0.1072	0.1305	0.1390*	0.0677	0.1692
	(0.0549)	(0.0743)	(0.0570)	(0.0789)	(0.0304)	(0.0480)	
Asia	0.4016*	-0.2397*	0.3768*	-0.1974	0.2552*	-0.1357*	0.1692
	(0.0785)	(0.1062)	(0.0814)	(0.1127)	(0.0434)	(0.0686)	
S.Amer	0.2097*	0.0395	0.2289*	0.1812*	0.0299	-0.1308*	0.2675
	(0.0639)	(0.0864)	(0.0663)	(0.0917)	(0.0353)	(0.0558)	

* significant at the .05 level

Table 22: Weekly Dispersion Regression with Brazil during Credit Crisis

Country	θ'_t	ω'_t	θ'_{t-1}	ω'_{t-1}	ψ'_1	ψ'_2	$Adj. R^2$
Thailand	0.4814*	-0.3336*	0.5660*	-0.4401*	0.5376*	-0.4142*	0.2574
	(0.0880)	(0.1183)	(0.0894)	(0.1278)	(0.0618)	(0.0994)	
Chile	0.0432	0.0178	0.0171	0.0539	0.2258*	-0.1064*	0.2002
	(0.0303)	(0.0407)	(0.0308)	(0.0440)	(0.0213)	(0.0342)	
China	0.3747*	-0.1631	0.5341*	-0.2887*	0.1251*	0.3183*	0.3114
	(0.0683)	(0.0918)	(0.0694)	(0.0992)	(0.0480)	(0.0772)	
Indonesia	0.4394*	-0.0887	0.7701*	-0.4116*	0.5746*	-0.2224	0.2777
	(0.1066)	(0.1433)	(0.1082)	(0.1548)	(0.0748)	(0.1204)	
India	0.0379	0.1564	0.0015	0.1662	0.2663*	-0.0790	0.0814
	(0.0811)	(0.1090)	(0.0823)	(0.1178)	(0.0569)	(0.0916)	
Korea	0.3257*	-0.1952	0.2874*	-0.0999	0.6204*	-0.4667*	0.1447
	(0.1115)	(0.1498)	(0.1132)	(0.1619)	(0.0783)	(0.1260)	
Mexico	0.2220*	-0.0598	0.1886*	0.1103	0.3026*	-0.1145*	0.3286
	(0.0477)	(0.0641)	(0.0484)	(0.0693)	(0.0335)	(0.0539)	
Malaysia	0.4529*	-0.3090*	0.5736*	-0.4750*	0.1917*	-0.0496	0.3305
	(0.0539)	(0.0724)	(0.0547)	(0.0783)	(0.0378)	(0.0609)	
Turkey	0.1654*	-0.0490	0.0875	0.1616	0.3654*	-0.3617*	0.1231
	(0.0734)	(0.0986)	(0.0745)	(0.1066)	(0.0515)	(0.0829)	
Taiwan	0.0863	-0.0026	0.0927	0.0132	0.1453*	-0.0108	0.0982
	(0.0465)	(0.0625)	(0.0472)	(0.0675)	(0.0326)	(0.0525)	
South Africa	0.2097*	-0.0733	0.1939*	-0.0716	0.3585*	-0.1392*	0.2559
	(0.0511)	(0.0686)	(0.0519)	(0.0742)	(0.0358)	(0.0577)	
EMEA	0.2637*	-0.0839	0.1183*	0.0331	0.2084*	0.1964*	0.2749
	(0.0541)	(0.0727)	(0.0549)	(0.0785)	(0.0380)	(0.0611)	
Asia	0.3817*	-0.2026	0.4047*	-0.2187	0.3196*	-0.1889*	0.1814
	(0.0789)	(0.1060)	(0.0801)	(0.1145)	(0.0553)	(0.0891)	
S.Amer	0.1689*	0.0684	0.1737*	0.1987*	0.2411*	-0.2222*	0.2031
	(0.0629)	(0.0845)	(0.0639)	(0.0913)	(0.0441)	(0.0711)	

* significant at the .05 level

Table 23: Weekly Dispersion Regression with Brazil during Brazil Elections

Country	θ'_t	ω'_t	θ'_{t-1}	ω'_{t-1}	ψ'_1	ψ'_2	$Adj.R^2$
Thailand	0.1691*	-0.0906	0.1673*	-0.2203	0.4443*	-0.4762	0.1515
	(0.0624)	(0.6965)	(0.0652)	(0.6948)	(0.0622)	(0.2877)	
Chile	0.0441*	0.0459	0.0240	0.1374	0.2049*	-0.1086	0.1901
	(0.0202)	(0.2257)	(0.0211)	(0.2252)	(0.0202)	(0.0932)	
China	0.2849*	0.2113	0.4229*	-0.7041	0.1935*	-0.4860*	0.3114
	(0.0453)	(0.5057)	(0.0474)	(0.5045)	(0.0452)	(0.2089)	
Indonesia	0.3117*	-0.8979	0.4654*	-0.8599	0.5161*	0.0499	0.2522
	(0.0719)	(0.8029)	(0.0752)	(0.8010)	(0.0717)	(0.3317)	
India	0.1378*	-0.2324	0.0959	-0.2490	0.2553*	-0.3931	0.0863
	(0.0536)	(0.5986)	(0.0561)	(0.5972)	(0.0535)	(0.2473)	
Korea	0.1236	0.5896	0.1028	-0.2347	0.5147*	0.2156	0.1030
	(0.0757)	(0.8452)	(0.0792)	(0.8432)	(0.0755)	(0.3491)	
Mexico	0.1814*	0.0081	0.2209*	0.0987	0.2797*	0.1042	0.3232
	(0.0318)	(0.3546)	(0.0332)	(0.3537)	(0.0317)	(0.1465)	
Malaysia	0.2063*	-0.0984	0.2462*	-0.2728	0.1742*	-0.1818	0.2151
	(0.0387)	(0.4320)	(0.0405)	(0.4310)	(0.0386)	(0.1785)	
Turkey	0.0978*	0.2824	0.0895	0.2504	0.2936*	-0.3101	0.0943
	(0.0494)	(0.5520)	(0.0517)	(0.5506)	(0.0493)	(0.2280)	
Taiwan	0.0826*	0.2471	0.1016*	-0.1705	0.1412*	0.1565	0.1037
	(0.0307)	(0.3432)	(0.0321)	(0.3423)	(0.0306)	(0.1417)	
South Africa	0.1389*	-0.4335	0.1120*	-0.3651	0.3258*	0.1070	0.2360
	(0.0343)	(0.3830)	(0.0359)	(0.3821)	(0.0342)	(0.1582)	
EMEA	0.2468*	-0.4767	0.1725*	-0.1450	0.2556*	-0.2382	0.2718
	(0.0359)	(0.4011)	(0.0376)	(0.4002)	(0.0358)	(0.1657)	
Asia	0.2091*	-0.3955	0.2053*	-0.1342	0.2773*	-0.2172	0.1466
	(0.0534)	(0.5960)	(0.0558)	(0.5946)	(0.0532)	(0.2462)	
S.Amer	0.2043*	-0.7006	0.2564*	-0.7002	0.1863*	0.9522*	0.2271
	(0.0411)	(0.4585)	(0.0430)	(0.4574)	(0.0410)	(0.1894)	

* significant at the .05 level