

On the Relationship Between Asian Sovereign Credit Default Swap Markets and Equity Markets

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Version: February 12, 2008

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Abstract

The Merton-type structural model, when extended to sovereign issuers, suggests a negative relationship between sovereign credit default swap (CDS) spreads and stock prices. Capital structure arbitrage strategy that exploits such relationships should foster the integration of CDS and the stock market and improve price discovery. This paper studies the dynamic relationship between sovereign CDS spreads and stock prices for seven Asian countries for the period from January 2001 to February 2007. We find a strong negative correlation between the CDS spread and the stock index for most Asian countries. A long-run equilibrium price relationship is found for China, Korea, and Thailand. The limited integration in other countries may arise from market frictions and model applicability. In terms of price discovery, CDS markets play a leading role in five out of seven countries. The stock market has a feedback effect for two countries and dominates price discovery for only one country. Therefore, equity investors should span the CDS market for incremental information.

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I. Introduction

Credit derivatives are financial instruments that offer protection against credit or default risk of bonds or loans. This new class of assets is designed to trade credit risk on a variety of corporate and sovereign names with a wide range of maturity. The credit derivatives market is primarily comprised of two sectors: the corporate sector, accounting for 80% of the market, and the sovereign sector, accounting for 20% of the market and mostly composed of credit derivatives on emerging sovereign bonds. According to the June 2006 survey by the International Swaps and Derivatives Association (ISDA), the notional amount of the credit derivatives market has exceeded \$26 trillion. Figure 1 presents the development of the global derivatives markets based on surveys from various sources.

The increased attention on hedging emerging market sovereign risk (such as the Asian financial crisis, the Argentine turmoil, the Russian bond default, and the recent Italian sovereign rating downgrade) has fueled the evolution of the sovereign credit derivative markets. The emerging credit derivatives (EMCD) market took off during the second half of 1997. The credit derivatives market performed reasonably well during the Russian bond default in 1998. However, the depth and liquidity in EMCD is substantially constrained by the depth and liquidity in the bond and repo emerging markets.

The development of the Asian credit derivatives market is fostered by the development of the underlying bond market since the Asian financial crisis in 1997. Asian local bond markets have grown rapidly since the crisis and the size of nine East Asian local bond markets was estimated to be US\$1.2 trillion at the end of 2002 (Hohensee and Lee 2004). The support

from regulators with an aim to develop the bond market also fosters improvements in the liquidity and diversity of credit derivative products. Since the mid-1990s, banks have turned to credit derivatives to manage more actively the concentration and correlation risk in their loan portfolios.

There is an active broker market for Asian sovereign CDSs. The collateral debt obligations (CDO) market is less developed in the EMCD market, primarily due to the high correlation between emerging markets.¹ Two-way pricing is available for the most liquid sovereign CDS names in one to thirty year range. The most liquid Asian sovereign CDSs are on Japan and the Philippines, the latter is regarded as the benchmark for Asian emerging markets. An active credit derivatives market provides tools to securitize credit risk that will help develop the overall bond market. It can improve the stability and efficiency of the financial system by pricing and diversifying credit risk.

This paper attempts to provide an overview of the Asian credit derivatives market by focusing on seven sovereign CDS names, i.e., three Northeast Asian countries—China, Japan and Korea—and four Southeast Asian countries—Indonesia, Malaysia, the Philippines, and Thailand. We find the Asian CDS spreads have gradually declined and converged, indicating better economic prospects and lower risk premiums demanded by market participants. Then we examine the equilibrium relationship between CDS spreads and stock index levels in each country for a period from 2001 to February 2007. Merton’s model predicts that a firm’s equity and bond prices (credit spread) are positively (negatively) correlated when debt-to-asset ratios are high or when default risk is high. Chan-Lau and Kim (2004) explain how Merton’s theory of firm can be extended to sovereigns. In an analogous way, a country’s default risk, captured

¹ Due to the low diversification effect across emerging markets, an emerging market CDO requires a much higher “first loss” or “equity” tranche retained by the sponsoring bank (typically 18% versus 2%-4%, which is typical in developed markets) to make the CDO marketable—hence usually rendering it uneconomical for the sponsor.

by CDS spreads, should be inversely related to stock prices. If the relationship between CDS spreads and stock prices does not hold, ideally, capital structure arbitrage should eliminate mispricing. However, the equilibrium relationship may not hold due to market frictions, or if a country has low default risk.

Furthermore, we investigate whether the fast developing CDS market is more important in price discovery than the stock market.² By nature, the sovereign CDS spread is supposed to compensate investors for bearing sovereign default risk. This should be driven by a country's economic fundamentals. A country's stock market has long been viewed as the economic barometer. A bearish or highly volatile stock market conveys a negative message to investors on the country's economic fundamentals. Given shallow stock markets in most Asian emerging countries, in contrast with the CDS market loaded with informed institutional investors, we expect that the sovereign CDS market leads the stock market. On the other hand, the stock market has "home" advantage and should incorporate more quickly information on macroeconomic conditions and micro-level firm fundamentals.

Our paper is closely related to Chan-Lau and Kim (2004). They examine the dynamic relationship between emerging market CDS spreads, bond spreads, and stock prices for eight emerging markets. However, the Philippines is the only Asian country in their sample. They find no evidence of equilibrium price relationship between the CDS and equity markets for most countries and mixed evidence for price discovery. Norden and Weber (2004) and Zhu (2006) examine the relationship between corporate CDS spreads, bond spreads and stock prices. But their focus is on corporate CDS. Fung et al. (2007) examine the lead-lag

² Studies on corporate CDS reveal that CDS prices lead stock prices during credit deterioration episodes at the firm and portfolio levels (CITE).

relationship between the U.S. CDS and stock markets at the portfolio level, and find mutual feedback between the high-yield CDS and stock markets.

Our results suggest that the CDS spread and the stock index are negatively correlated for six out of seven Asian countries with the exception of China. The findings imply that in assessing the country-specific factor for sovereign risk, the stock index is a good candidate. In terms of price discovery, we find that price discovery takes place primarily in the CDS market. We speculate that price discovery occurs in the CDS market because of fewer restrictions, broader investor base, and greater information advantage in the CDS market. In contrast, the stock market is relatively shallow and less developed. Therefore, equity investors should span the sovereign CDS market for incremental information for trading and hedging purposes.

II. The Issue

Diverse financial products are traded in the credit derivatives market, such as Credit Default Swaps (CDS), Collateral Debt Obligations (CDO), CDS indices, and portfolio swaps, among others. Credit default swaps are the simplest type of credit derivatives and the building block of the credit derivatives market. A CDS resembles an insurance contract, in that the protection buyer makes periodic payments (CDS premium/spread) over the life of the swap contract, in exchange for protection against default or other adverse credit events specified in the contract. Essentially, the purchase of a CDS is equivalent to shorting credit risk on the credit market (bond/loan market). Selling a CDS is equivalent to having a long exposure on the credit market. The market price of the CDS (i.e., CDS premium/spread) reflects the risk of the underlying credit. The CDS market allows the transfer of credit risk from lenders and big

bondholders to insurers, reinsurers and hedge fund managers who often take one-way bets by selling credit risk protection.

Sovereign CDS provides an ideal platform to gauge market views on a country's default risk. The changes in sovereign default risk not only affect CDS spreads on the country, but they also affect the country's equity prices. The relationship between the sovereign CDS and equity markets, to a certain extent, resembles that between equity and bond prices in the Merton (1974) framework.³

In his model, Merton notes that a firm's liabilities constitute a barrier point for the value of its assets. Within this framework, he notes that if the value of a firm's assets falls below the face value of its debt, the firm would default. Bond and equity prices are positively correlated, and the correlation is stronger when default risk is a major concern. Typical firms fitting this bond-equity price pattern are those with high debt-to-equity ratios and below investment-grade credit ratings. In other words, equity prices convey useful information on sovereign risk when this risk is high (an out-of-the-money situation faced by countries). Equity prices are less useful to gauge sovereign risk when the risk is low (an in-the-money situation faced by countries), as equity prices are affected more by factors other than default risk.

In practice, the sovereign CDS market and the stock market may become integrated due to capital structure arbitrage, which is one of the most recent hedge fund strategies based on Merton's theory. The strategy aims to exploit the pricing inefficiency that exists in the capital structure of the same firm. In essence, the capital structure arbitrageur uses a Merton-type structural model to compare the market CDS spread and the theoretical spread inferred from the model. The model predicts spreads based on a company's liability structure and its market value of equities. If the CDS spread is substantially larger than the predicted spread

³ Chan-Lau and Kim (2004) justified extending the theory from a corporate to a sovereign issuer.

based on stock prices, an arbitrageur can sell credit protection if he believes that the equity market is right, or sell equity if he believes the CDS spread is right. In practice, the arbitrageur is probably unsure whether equity market or CDS spread is right. Hence, the arbitrageur does both strategies of selling credit protection and shorting equity. Both strategies would make profits when the CDS spread and the model spread converge with each other. The argument is that the theoretical relation between the CDS spread and the equity price would prevail in the end, and the equity position can cushion the loss of the CDS position, and vice versa (Yu 2006).

Arbitrage opportunities arise from the relative mis-pricings of various forms of capital employed by a firm. However, arbitrage behaviors by hedge funds will quickly wipe off such opportunities, making markets more efficient, and fostering the integration of two markets. In an analogous way, capital structure arbitrage strategy can be applied in the sovereign CDS market and stock market. For example, when a country has a higher default risk, its stock market performance will be adversely affected either due to deteriorating economic fundamentals, or greater risk premium demanded by investors home and abroad, or both. Thus, the price of the country's stock market would fall. When a country is in this situation, buying insurance against its default becomes more expensive. Therefore, the CDS spread would rise. Also, the demand for protection against the country's potential default increases as credit risk increases. This, in turn, causes further downward pressure on equity prices as sellers of credit derivatives protection hedge their exposure by either shorting bonds, or equity. Therefore, the stock market is expected to be negatively related to the sovereign CDS spread.

Moreover, the CDS market offers an ideal laboratory to explore the expectations of the credit (sovereign) risk embedded in default swap prices. Market practitioners claim that the

CDS market reacts first to new information on credit risk. Recent empirical studies appear to validate this claim for corporate issuers in Europe and the United States. For instance, Blanco, Brennan, and Marsh (2003) analyze a large panel of U.S. and European corporate issuers and find that CDS spreads lead bond spreads during credit-deterioration episodes. Longstaff, Mithal, and Neiss (2003) study a large sample of corporate issuers in the United States and found that the CDS and equity markets contain distinct information. Using the CDX index, Fung et al. (2007) find that there exists two-way interaction between the U.S. stock index and the high-yield CDX indices. However, the research on the price discovery function of the sovereign CDS market is limited. Zhang (2003) finds that Argentina's CDS predicts credit events in the country well before the rating agencies, which had assigned over-generous ratings to the Argentine debt, and the rating agencies lagged the credit market in downgrading the debt. Chan-Lau (2004) find that there is mixed evidence for emerging market sovereign CDS.

Is there a long-run equilibrium relationship between Asian sovereign CDS and stock markets? Which market is more important in price discovery? What implications can we find for emerging market sovereign issuers? We address these questions and examine the equilibrium price relationships and price discovery in the CDS and equity markets for seven Asian countries: China, Indonesia, Japan, Korea, Malaysia, the Philippines, and Thailand.

III. Data

To study the relationship between sovereign CDS spread and stock prices in the Asian market, we focus on three Northeast Asian countries—China, Japan, and Korea—and four Southeast Asian countries—Indonesia, Malaysia, the Philippines, and Thailand. The CDS of

these countries are among the most liquid sovereign CDS traded in the sovereign credit derivatives market. According to Fitch Ratings (2006), the Philippines and Japan are among the top-25 reference entities for year-end 2005, in terms of gross-bought protection by volume. The Philippines CDS market is regarded as the benchmark in the Asian emerging markets. The great demand for buying CDS spreads on the Philippines may reflect that investors look to hedge their exposure to the Philippines sovereign and non-sovereign debt, and cross-hedge their exposure to other Asian emerging countries' sovereign and non-sovereign debt as well. Japan is also on the top-25 list in terms of the gross-sold protection by volume.⁴ This greater demand for buying and selling protection on Japan may reflect the country's deep and liquid bond market.

We use sovereign CDS spreads taken from a comprehensive dataset provided by the Markit Group Limited.⁵ The Markit Group collects corporate and sovereign CDS quotes contributed by more than 30 large banks on a daily basis. A daily CDS spread is a composite quote only if it has more than three contributors. Once a credit default swap is priced by Markit, the pricing data is generally on a continuous basis. The data spans from January 2001 to February 2007. We use only the five-year spreads because these swap contracts are the most liquid. To maintain uniformity in contracts, we only use CDS quotes denominated in U.S. dollars.

The equity prices are obtained from the Global Insights database. Following is a list of the equity market indices for each of the seven Asian countries:

- China: Shanghai Composite Index
- Japan: Nikkei 225 Index

⁴ Fitch Ratings (2006).

⁵ This dataset has been widely used for the research on credit default swaps. For example, it was used by Jorion and Zhang (2007), Remolona et al. (2007), Yu (2006), and Zhu et al. (2006).

- Korea: Korea Composite Stock Price Index (KOSPI)
- Indonesia: Jakarta Composite Index
- Malaysia: Kuala Lumpur Stock Exchange Composite Index
- The Philippines: The Philippines Stock Exchange (PSE) Composite Index
- Thailand: Stock Exchange of Thailand (SET) Index

Figure 2 shows the sovereign CDS spreads for these seven Asian countries from January 2001 to February 2007. The CDS spread on the Philippines declined from over 500 basis points in 2001 to about 100 basis points recently, reflecting a perception of lowered sovereign risk for the Philippines. The Indonesia spread exhibited a similar pattern but is about 100 basis points lower than that of the Philippines for the period 2003 to 2005. However, since 2006 their CDS spreads have started to converge, reaching a level of 100 basis points in early 2007—the lowest since 2001. The CDS spreads on the other five countries were lower than 50 basis points in February 2007. The gradually narrowing CDS spreads reflect investors' confidence on the Asian markets since the 1997 Asian crisis. In particular, the CDS spread on Japan ranges from 4 basis points to 20 basis points, consistently lower than all other Asian countries. Among the rest of the four countries, the CDS spreads of China appear to have the lowest volatility, compared to those of Korea, Malaysia, and Thailand.

Table 1 provides summary statistics on the CDS data and the equity indices. Indonesia and the Philippines have speculative-grade ratings, and their CDS spreads have an average of 262bp and 380bp. The remaining five countries have investment-grade ratings and their CDS spreads are substantially lower. It is interesting to note that the average CDS spread for Japan is 8bp and its variance is very low. However, its stock index has a very large variance. The rightmost column shows that stock prices and CDS spreads are negatively correlated for all

countries with the exception of China. Among the countries with negatively correlated stock prices and CDS spread, the correlations are greater than 70% in absolute value and all are significant at the 1% level. As anticipated, these correlation patterns strongly reflect the price relationships that we noted earlier.

Figure 3 provides graphic representations of the CDS prices and stock index levels in local currencies for each of the seven countries. Most countries exhibit an inverse relationship between the two data series over the whole sample period. The only exception is China. The correlation is 0.30 over the whole period. This may suggest that China's stock market is a poor indicator of the country's economic fundamentals. Figure 3 shows that the Shanghai Stock Exchange Index has slid all the way from over 2,200 points in 2001 to 1,000 points in 2005, a loss of more than 50%, and only started to reverse itself in 2006. During the same period, the real GDP of China grew, on average, by over 9.3 percent a year. The poor performance of the Shanghai and Shenzhen exchanges, in contrast with bright economic prospects, suggests that China's stock market was an underdeveloped and highly regulated market. This may explain the positive value for the correlation between China's CDS spreads and stock prices. Notably, the value for the period from 2005 to February 2007 becomes -0.82 and significant at the 1% level in China. Consequently, we focus on 2005 to February 2007 period for the analysis of the relationship between China's CDS spreads and stock prices.

IV. Empirical Analysis

Long Run Price Equilibrium

If the CDS market and the stock market price sovereign risk are equal in the long run, then their prices should be cointegrated. The ordinary least square estimation method would

falsely suggest that the variables are closely connected by a linear equation even though they are completely independent of each other. We test for the existence of equilibrium price relationships or cointegrating equations using a two-step approach. First, we examine whether the price series are characterized by a unit root using Augmented Dickey-Fuller and Phillips-Perron unit root tests. The null hypothesis in both tests is that the series are characterized by unit root tests. Test statistics show that we cannot reject a unit root for both series for all countries. However, the hypothesis of a unit root in the first differences is rejected for all series for all countries.⁶

Johansen's cointegration rank tests evaluate the null hypothesis of no-cointegration. This null hypothesis states that the coefficient matrix has full rank (equal to 2 for the two series). If this null hypothesis is rejected, then the two price series are cointegrated and we can affirm that there exists an equilibrium price relationship between them.

We report Johansen cointegration test results for each reference entity in Table 2. There is evidence of cointegration between CDS spread and stock prices for China, Korea, and Thailand. For China, we can reject the null hypothesis of no-cointegration at the 5% level for the period of January 2005 to February 2007 and at the 10% level for the whole period. We find strong support for cointegration at the 5% level for Korea, suggesting that, on average, the sovereign risk is priced by CDS and stock markets equally over the long run. For Thailand, we can reject no-cointegration at the 10% level, but not at the 5% level. The existence of the equilibrium price relationship between the CDS and equity markets provides evidence that the arbitrage process forces the integration of CDS stock markets in these countries in spite of the market frictions and other various technical factors.

⁶ Results are not reported in this article, but are available upon request.

Japan, Indonesia, Malaysia, and the Philippines are among the countries on the list that reject cointegration. The absence of cointegration can be attributed to these countries having low debt-to-asset values or that these countries' leverage fluctuates widely. Specifically, when a country has low debt-to-asset values, it is difficult to estimate an equilibrium price relationship because the correlation between CDS spread and equity prices is also low. When a country's leverage fluctuates widely, CDS spreads and equity prices may be characterized by a nonlinear relationship that cointegration analysis cannot capture. The former condition (low debt-to-asset values) may help to explain why there is no cointegration between CDS and stock markets in Japan, which has high sovereign ratings and low sovereign risk. The latter condition (volatile leverage) may explain the absence of cointegration for the other three countries, which have experienced a financial crisis in the past.

There may be other explanations for no-integration. First, in the emerging countries the arbitrage opportunities across CDS and equity markets cannot be exploited because of the market frictions or technical factors. Second, CDS prices of the emerging countries not only reflect sovereign risk that is based on economic conditions, which should be incorporated in stock prices, but also reflect risk premium for taking on sovereign default risk, which is different from risk premium in the stock market. Remolona et al. (2007) find that the remarkable narrowing of emerging markets CDS spreads between 2002 and 2006 has largely come about from a major narrowing of the risk premium gaps for speculative-grade issuers because global investors have become hungrier for speculative grade debt. In contrast, the falling spreads for the investment-grade group is largely due to an actual decline in sovereign risk because economic conditions have improved (risk premiums have remained fairly stable). Due to different market participants in the CDS and stock markets, if the risk premium in the

CDS market differs from that in the stock market, it is natural that there is no long-run equilibrium relationship between these two markets.

Price Discovery

One of the most important functions of the financial markets is price discovery, defined by Lehmann (2002) to be the efficient and timely incorporation of the information implicit in investor trading into market prices. When closely related assets trade in different markets, it is important to investigate which of the markets contributes most to the discovery process.

The existence of cointegration means that at least one market has to adjust by the Granger Representation Theorem (Engle and Granger, 1987). To investigate the mechanics of price discovery for the cointegrated series, we adopted two tests. Following Blanco et al., we use Hasbrouck-bound tests proposed in Hasbrouck (1995) and the Gonzalo and Granger (1995) test, both of which rely on vector error correction models (VECM) of market prices. Hasbrouck's model of "information shares" assumes that price volatility reflects new information, and so the market that contributes most to the variance of the innovations to the common factor is presumed to also contribute most to price discovery. When price change innovations are correlated, Hasbrouck's approach can only provide upper and lower bounds on the information shares of each market. Gonzalo and Granger's approach decomposes the common factor itself and by ignoring the correlation between the markets, attributes superior price discovery to the market that adjusts least to price movements in the other market.

We first estimate the VECMs as the following:

$$\Delta p_{CDS,t} = \lambda_1 (p_{CDS,t-1} - \alpha_0 - \alpha_1 p_{SP,t-1}) + \sum_{j=1}^p \beta_{1j} \Delta p_{CDS,t-j} + \sum_{j=1}^p \delta_{1j} \Delta p_{SP,t-j} + \varepsilon_{1t}$$

$$\Delta p_{SP,t} = \lambda_2 (p_{CDS,t-1} - \alpha_0 - \alpha_1 p_{SP,t-1}) + \sum_{j=1}^p \beta_{2j} \Delta p_{CDS,t-j} + \sum_{j=1}^p \delta_{2j} \Delta p_{SP,t-j} + \varepsilon_{2t}$$

where CDS and SP refer to CDS spreads and stock prices. If the stock market is contributing significantly to the discovery of the price of sovereign risk, then λ_1 will be statistically significant as the CDS market adjusts to incorporate this information. Similarly, if the CDS market is an important venue for price discovery, then λ_2 will be statistically significant. The stock market is inefficient since the price reacts to publicly available information.

The contributions of market 1 (the CDS market) to price discovery are defined by the following expressions:

$$HAS_1 = \frac{\lambda_2^2 \left(\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2} \right)}{\lambda_2^2 \sigma_1^2 - 2\lambda_1 \lambda_2 \sigma_{12} + \lambda_1^2 \sigma_2^2} \quad HAS_2 = \frac{\left(\lambda_2 \sigma_1 - \lambda_1 \frac{\sigma_{12}}{\sigma_1} \right)^2}{\lambda_2^2 \sigma_1^2 - 2\lambda_1 \lambda_2 \sigma_{12} + \lambda_1^2 \sigma_2^2}$$

$$GG = \frac{\lambda_2}{\lambda_2 - \lambda_1}$$

where HAS_1 and HAS_2 give the two bounds of Hasbrouck's measures and GG stands for the Gonzalo and Granger measure. The covariance matrix of ε_{1t} and ε_{2t} is represented by the terms σ_{12} , σ_{12} , σ_{22} . If GG is equal to 1, then the CDS market contributes to the price discovery; if GG is equal to 0, then the stock market contributes to the price discovery; if GG is equal to 0.5, then both markets contribute. The price discovery statistics are reported in Table 3 for those entities where cointegration is present between CDS spreads and stock prices.

As shown in Table 3, we find that in China, both CDS and the stock market contribute significantly to price discovery, but the CDS market is dominant (defined by both the Hasbrouck lower bound and the Gonzalo-Granger measure suggesting more than 70% of the discovery occurring in the CDS market). This may be due to easy access to the CDS market by international investors, relative to the stock market, which has not been fully opened to

international investors. The market entry barriers for global investors may restrict the price discovery function in the stock market. In Thailand, the CDS market is also more important (more than 80%) for the price discovery process. The coefficient estimates (Hasbrouck and Granger-Gonzalo statistics) provide consistent and robust evidence. In contrast, Korea's stock market is more important for price discovery as the coefficient estimate λ_1 is statistically significant so the CDS market adjusts to incorporate information. This is also suggested by the Hasbrouck upper and lower bounds, which are close to 0. The Granger-Gonzalo statistic, however, shows that both markets contribute.

For the sub-sample reference entities where cointegration is rejected and hence the VECM representation is not valid, we rely on the concept of Granger causality in a VAR in differences to test for price leadership. Since the hypothesis of a unit root in the first difference is rejected for both series, we use the CDS spread changes and stock returns as variables in the VAR system. In this test, the null hypothesis is that prices in one market did not Granger-cause prices in the other market, or equivalently, that price discovery does not occur in the first market.

Table 4 shows the F-statistics and probability values (p-values) corresponding to the null hypothesis for the optimal lags based on minimized information criteria. Table 4 shows that CDS spread changes Granger-cause stock returns for three of four countries, i.e., Indonesia, Malaysia, and the Philippines. For Japan, there is no causation in either direction. From our discussion on narrow CDS spreads and volatile stock prices for Japan, this is consistent with the explanation that changes in the equity prices may be affected by factors other than default risk when countries have low sovereign risk (in-the-money). On the other hand, stock returns Granger-cause CDS spread changes for Indonesia and the Philippines,

indicating bi-directional causality. This is consistent with the explanation that equity prices convey useful information on sovereign risk when this risk is high (a situation faced by countries out-of-the-money).

We conjecture that the leadership of the CDS spreads in the price discovery may be due to two reasons. First, the CDS market is the forum for trading sovereign risk. Investors hedging bond, loan, stock, and counterparty exposures are able to do so in the CDS market. The concentration of liquidity from different pools may help make the CDS market lead the stock market. Second, participants in the CDS market, which are large intuitional investors, may have information advantage that will be subsequently incorporated into the stock market.

V. Conclusion

This paper contributes to the relatively small empirical literature on emerging market credit derivatives. To our knowledge, this paper is the first to examine credit default swap prices in a time series framework for Asian sovereign CDS market. It addresses the dynamic relationship between credit default swap prices and stock prices using data for seven Asian countries for which high-quality data are available.

CDS spreads have declined substantially to about 100bp for speculative-grade issuers and below 60bp for investment-grade issuers in 2007, reflecting global investors' improving confidence in Asian economies. Most Asian stock markets also exhibited strong performance from 2001 to 2007, after being hard hit by a financial crisis. China's stock market has been the worst performer in the Asian market, but started to gain momentum since July 2005.

Overall, we find high and significant, negative correlation between the CDS spread and the stock index for six out of seven Asian countries with the exception of China. The negative

correlation findings suggest that in assessing the country-specific factor for sovereign risk, the stock index is a good candidate. The correlation turns out to be negative for China since 2005, indicating that China's stock market improved its performance and should serve as a better indicator of country risk in the future.

Using the cointegration techniques, the long-run equilibrium relationship between CDS spreads and stock prices is found in markets in China (since 2005), Thailand, and Korea, implying that a capital structure arbitrage strategy may be successful in these countries. No equilibrium price relationship between the CDS and equity markets was found in the other four countries, which can be due to low default risk, as in the case of Japan, or volatile leverage, as in the case of Indonesia, the Philippines, and Malaysia. We conjecture that market imperfections in the CDS or the stock market may be responsible for the no cointegration results.

In terms of price discovery within a VAR (VECM) framework, we find that price discovery takes place primarily in the CDS market. We speculate that price discovery occurs in the CDS market because of fewer restrictions, broader investor base, and greater information advantage in the CDS market. In contrast, the stock market is relatively shallow and less developed. Therefore, equity investors should span the sovereign CDS market for incremental information for trading and hedging purposes. Conversely, the stock market has a feedback effect for Indonesia and the Philippines. The CDS market investors of the Philippines and Indonesia can gain additional information from their stock markets. Stock prices play a dominant role in price discovery for only one country, Korea. We find no lead-lag relationship for Japan, which is a developed country with low-sovereign risk.

Along with other sections of the credit derivatives market, Asian credit derivatives markets are expected to keep growing—and the growth is expected to be robust. The dynamic relationship between the credit derivatives market and the stock market in Asian countries will also evolve accordingly. We expect the two markets to become more integrated with fewer market restrictions, a greater participant's base, and more standardized derivatives market. The development will enable investors to exploit more arbitrage opportunities, which, in turn, will help to foster market integration and price discovery function of the financial markets.

References

- Blanco, R., S. Brennan, and I. Marsh. 2005. An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps. *Journal of Finance* 60:2255-2281.
- Chan-Lau, J.A. and Y.S. Kim. 2004. Equity Prices, Credit Default Swaps, and Bond Spreads in Emerging Markets. Working paper, International Monetary Fund, Washington, DC.
- Engle, R F and C.W.J. Granger. 1987. Cointegration and error-correction representation, estimation and testing. *Econometrica* 55:251-76.
- Fitch Ratings Special Report, *Global Credit Derivatives Survey: Indices Dominate Growth as Banks' Risk Position Shifts*. September 2006.
- Fung, H.G., G. Sierra, J. Yau, and G. Zhang. 2007. Are the U.S. Stock Market and Credit Default Swap Market Related? Evidence from the CDX Indices. Working Paper, University of Missouri-St. Louis.
- Gonzalo, J and C.W.J. Granger. 1995. Estimation of common long-memory components in cointegrated systems. *Journal of Business and Economic Statistics* . 13:27-35.
- Hasbrouck, J. 1995. One security, many markets: determining the contributions to pricediscovery. *Journal of Finance* 50:1,175-99.
- Hohensee M. and K. Lee. 2004. A survey on hedging markets in Asia: A description of Asian derivatives markets from a practical perspective. Bank for International Settlement Working Paper.
- A Report by the International Capital Markets Department on Market Developments and Issues. *IMF Global Financial Stability Report*, Chapter 2: "The Influence of Credit Derivative and Structured Credit Markets on Financial Stability." 2006.

- Jorion, P. and G. Zhang. 2007. Good and bad credit contagion, evidence from credit default swaps. *Journal of Financial Economics* 84(3):860-883.
- Lehmann, B. N. 2002. Some desiderata for the measurement of price discovery across Markets. *Journal of Financial Markets*, 5:259-76.
- Merton, R.C. 1974. On the pricing of corporate debt: the risk structure of interest rates. *Journal of Finance* 29:449-70.
- Norden, L. and M. Weber. 2004. The co-movement of credit default swap, bond and stock markets: An empirical analysis. Working paper, University of Mannheim.
- Ranciere, R. G. 2002. Credit Derivatives in Emerging Markets. IMF Policy Discussion Paper, April, 2002.
- Remolona, E. M. Scatigna and E. Wu. 2007. The pricing of sovereign risk in emerging markets: Fundamentals and risk aversion. Working paper, University of New South Wales.
- The Joint Forum. 2005. Basel Committee on Banking Supervision, Credit Risk Transfer, Working Group on Risk Assessment and Capital, Basel: Bank for International Settlements, March.
- Yu, F. 2006. How profitable is capital structure arbitrage? *Financial Analysts Journal* 62(5):47-62.
- Zhang, X. F. 2003. What did the credit market expect of Argentina Default? Evidence from default swap data, Working paper.
- Zhu, H. 2006. An empirical comparison of credit spreads between the bond market and the credit default swap market. *Journal of Financial Services Research* 29(3):211-235.

Figure 1: Growth of Global Credit Default Swap Market

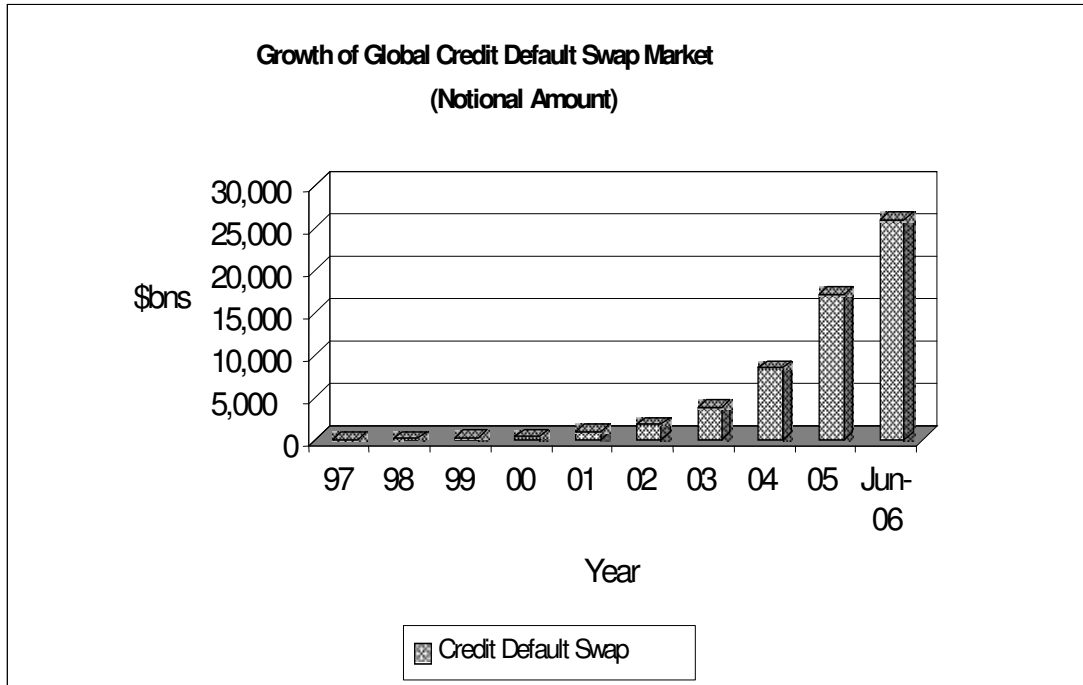


Figure 2: CDS Spreads of Seven Asian Countries (January 2001 to February 2007)

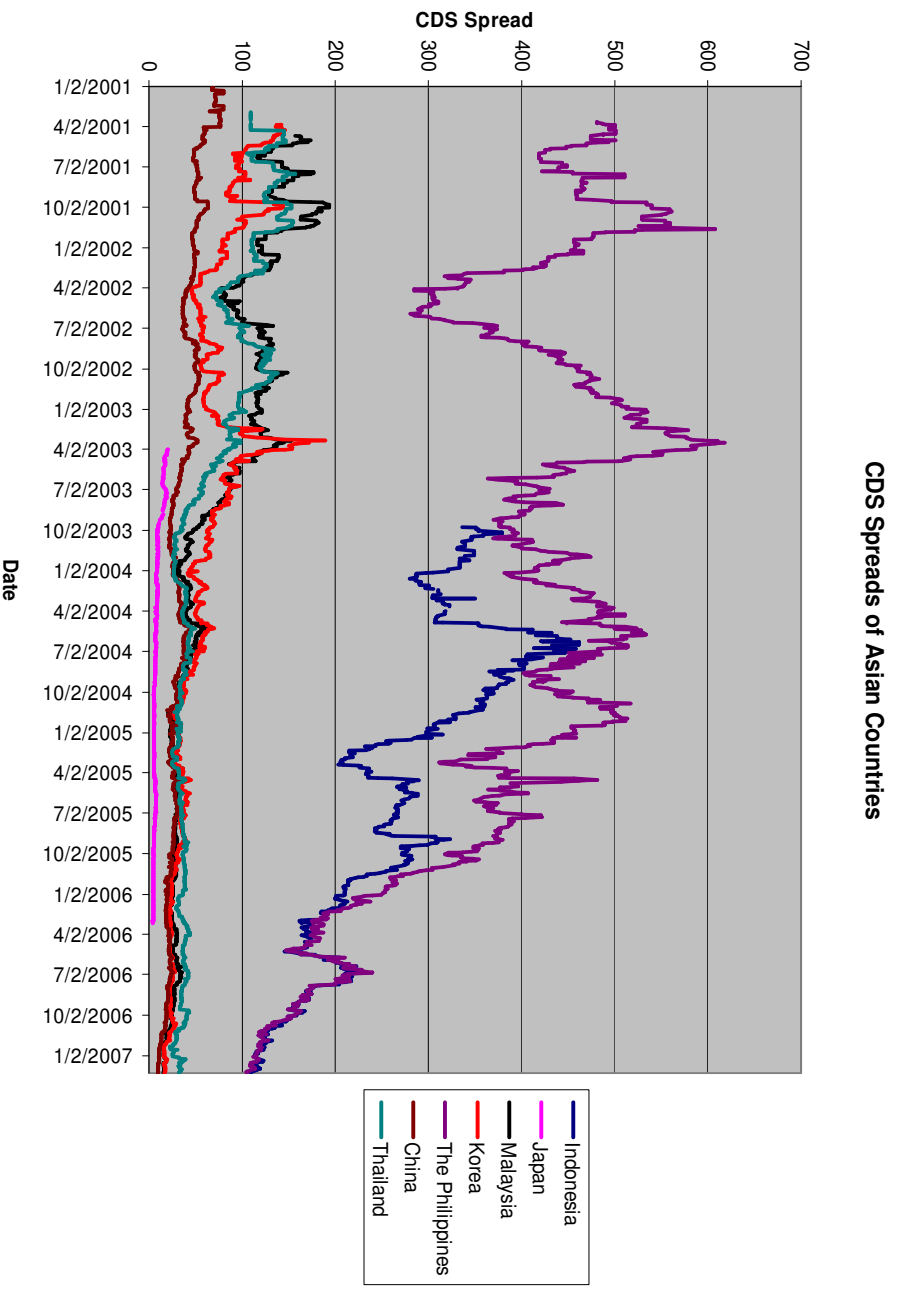
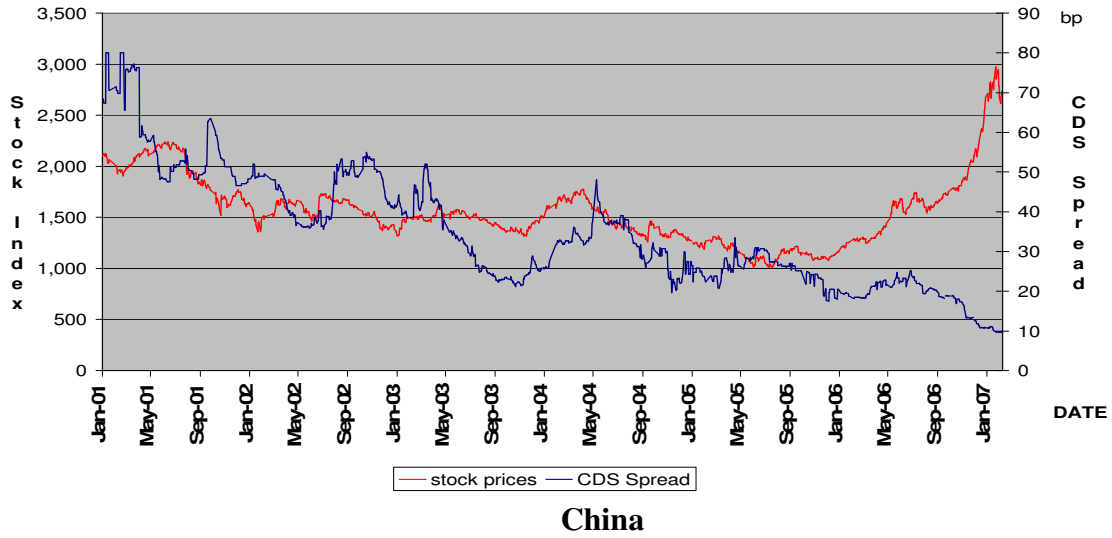
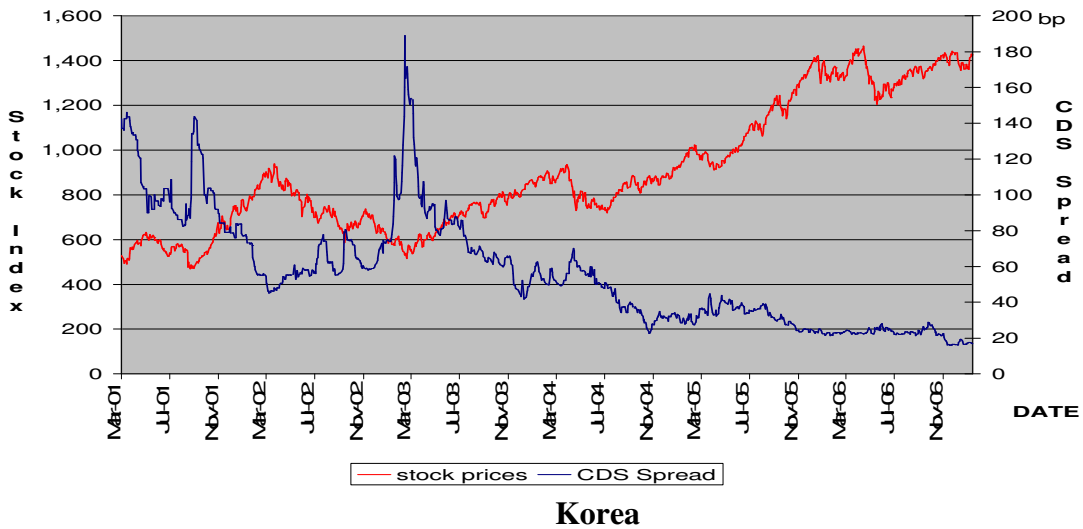


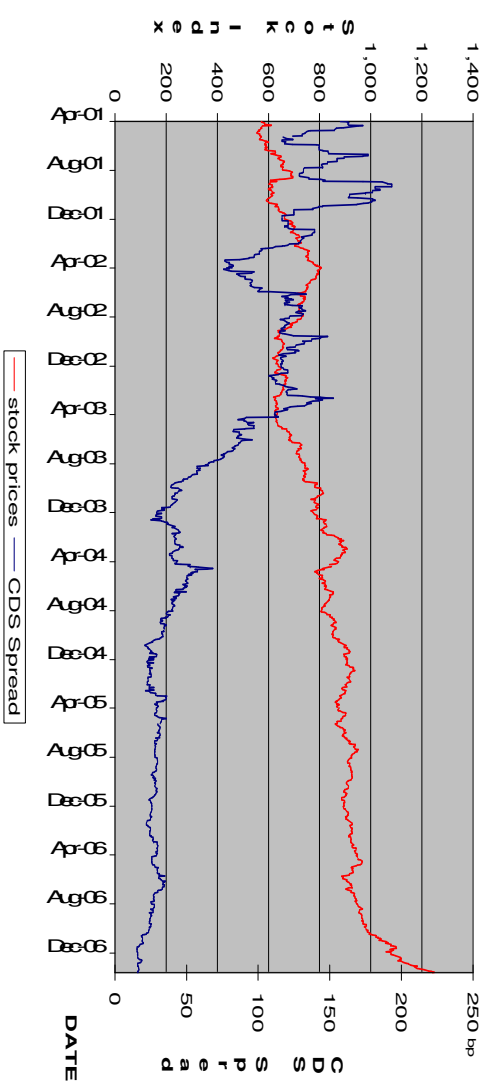
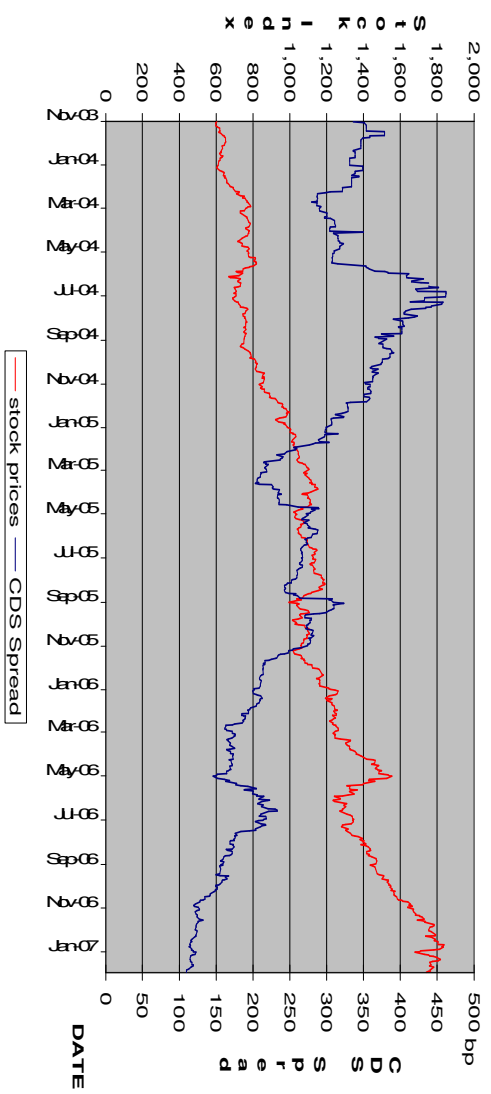
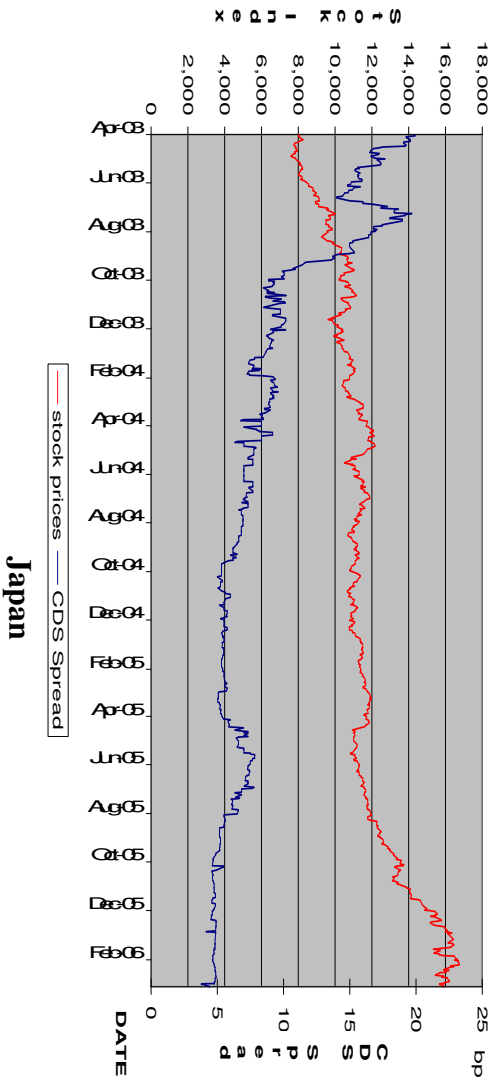
Figure 3: Stock prices and CDS spreads in various countries

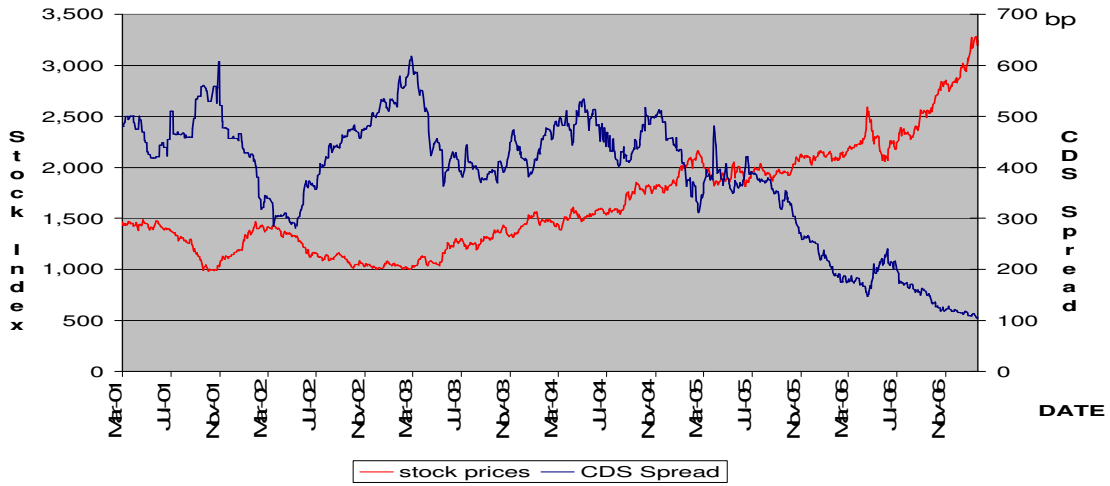


China

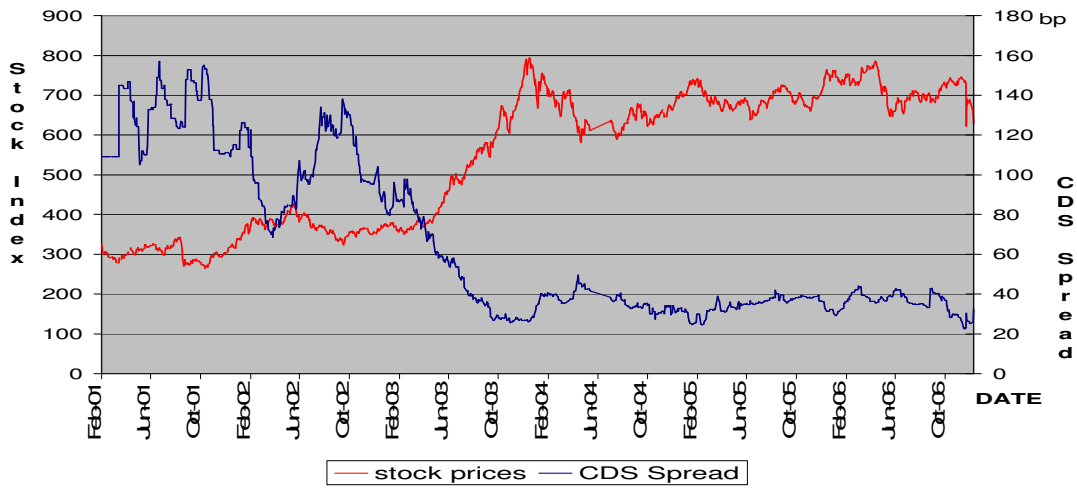


Korea





The Philippines



Thailand

Table 1. Summary Statistics

This table lists the reference entities in our sample, together with the Standard & Poor (S&P's) sovereign rating and the summary statistics for credit default swap spread series and stock market indices.

Country	S&P Rating	CDS Spread					Stock Prices					Corr.
		N	Mean	Std. Dev.	Min.	Max.	N	Mean	Std. Dev.	Min.	Max.	
China	A	1582	35	15	10	80	1540	1647	513	1012	4335	0.30***
Japan	AA	758	8	4	4	20	1580	12229	2707	7608	18215	-0.72***
Korea	A	1521	56	31	16	189	1591	917	304	469	1663	-0.83***
Indonesia	BB-	869	262	87	109	462	1546	859	460	337	2104	-0.91***
Malaysia	A-	1504	68	48	15	193	1584	823	165	553	1368	-0.88***
The Philippines	BB-	1527	380	123	104	618	1590	1721	596	979	3505	-0.83***
Thailand	BBB+	1536	64	39	23	157	1453	536	173	0	794	-0.92***

Table 2. Johansen's Cointegration Rank Tests

This table reports Johansen's trace statistics for the null hypothesis of no-cointegration. Only significant trace statistics rejecting the null hypothesis at the 10% confidence level or below are reported.

	CDS spreads and equity prices
China+	16.10**
Japan	No cointegration
Korea	17.72**
Indonesia	No cointegration
Malaysia	No cointegration
The Philippines	No cointegration
Thailand	14.83*

+The cointegration test for China's CDS spreads and stock index levels spans the period of January 2005-February 2007. For the whole period, the trace statistic is 15.74, which is significant at the 10% level.

Table 3: Price Discovery Measures

This table reports the error-correction coefficients corresponding to the VECM. It also reports the lower and upper Hasbrouck bounds and the Granger-Gonzalo statistics.

	CDS	t-stat	Stock	t-stat	Hasbrouck		Granger-Gonzalo statistics
					Lower	Upper	
	equation		equation		bound	bound	
China	-0.01**	-2.13	-0.16***	-3.65	0.73	0.75	1.03
Korea	-0.02***	-4.29	0.02	0.79	0.01	0.03	0.49
Thailand	-0.01	-1.28	-0.05***	-3.46	0.8	0.89	1.12

Table 4: Granger causality test of credit default swap spreads and equity prices

This table reports the F-statistics and p-values (in italics) corresponding to the Granger Causality Tests applied to CDS spreads and equity prices.

	Japan	Indonesia	Malaysia	Philippines
Null Hypothesis				
CDS spreads does not Granger-cause equity prices	1.68	8.94**	7.28**	14.47***
p-value	0.43	0.01	0.02	<0.0001
Equity prices does not Granger-cause CDS spreads	1.35	5.27*	2.31	9.51***
p-value	0.51	0.07	0.32	0.002