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Testing Creditor Moral Hazard in Souvereign Bond Markets: A Unified Theoretical Approach and Empirical Evidence

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Testing Creditor Moral Hazard in Sovereign Bond Markets:

A Unified Theoretical Approach and Empirical Evidence

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Testing Creditor Moral Hazard in Sovereign Bond Markets:

A Unified Theoretical Approach and Empirical Evidence

Abstract

This paper critically evaluates the existing empirical literature on creditor moral hazard in sovereign bond markets, proposes a unified theoretical approach to test for IMF-induced creditor moral hazard, and provides empirical evidence, using daily sovereign bond market spreads of Indonesia and Korea. The results suggest that IMF-related news regarding program negotiations and approval may be associated with creditor moral hazard, but their impact on spreads is short-lived, indicating that creditor moral hazard could be best described as a short-run phenomenon.

1. Introduction

Creditor moral hazard is the hypothesis that an expected IMF support to a country may provide an implicit guarantee to its creditors regarding their returns, which motivates investors to take excessive risks (Edwards, 1998; Eichengreen, 2000; Feldstein, 1998; Schultz *et al.*, 1998; Schwartz, 1998). The IMF support to Mexico in 1995, which preceded financial crises in South East Asia (1997), Russia (1998), and Brazil (1998), has led to the contention that IMF funds to a crisis country cause creditor moral hazard in financial markets. For example, Friedman (1998) argued that the IMF's support to Mexico "… encouraged individuals and financial institutions to lend to and invest in the East Asian countries, drawn by high domestic interest rates and returns on investment, and reassured about currency risk by the belief that the IMF would bail them out if the unexpected happened and the exchange pegs broke."

Following initial empirical studies concerning creditor moral hazard that emerged in the late 1990s, the interest in quantifying this type of moral hazard has been raising since then. The motivation for our work on creditor moral hazard in sovereign bond markets is based on the several observations about the existing literature. First, all related empirical studies employ the Emerging Market Bond Index (EMBI), which overwhelmingly represents the Latin American debt. One may question the validity of using the EMBI to find for creditor moral hazard for non-Latin countries, due to its specific focus. Second, previous studies utilize a time period of more than one year for IMF program variables to capture creditor moral hazard effects. This seems to be a fairly long time for creditor moral hazard to last, especially given the highly-reversible nature

of international portfolio flows, as reported in Sarno and Taylor (1999). Indeed, the results in this paper suggest that creditor moral hazard may last only for a very short time. Third, even though understanding investor behavior towards IMF-related news is of critical importance to make correct inferences about creditor moral hazard, this question has not received much attention in the literature. Finally, previous studies use OLS estimations of daily bond spreads, which assumes constant variance of spreads. If bond spreads exhibit time-varying volatility, OLS estimates may lead to biased inferences.

Motivated by these observations, this paper assesses whether previous work has adequately tested the creditor moral hazard hypothesis, discusses the nature of creditor moral hazard and difficulties associated with its measurement, offers a unified theoretical approach to test for creditor moral hazard in sovereign bond markets, and provides empirical evidence from daily Indonesian and Korean bond spreads.

The paper is organized as follows. Section 2 compares and evaluates the methods and the results of previous empirical studies on creditor moral hazard in bond markets. Section 3 establishes a new framework for testing creditor moral hazard in bond markets. Section 4 summarizes the results of the empirical analysis. Finally, Section 5 provides concluding remarks and suggestions for future research.

2. Review of Existing Literature on Creditor Moral Hazard in Bond Markets

Table 1 provides an overview of existing empirical studies on creditor moral hazard by Sarno & Taylor (1999), Kamin & Kleist (1999), Zhang (1999), Lane & Phillips (2000), Tillmann (2001), and Dell'Ariccia, Schnabel, and Zettelmeyer (2002).

There is a fundamental difference between the approach adopted by Sarno and Taylor (1999) and other contributors. While most empirical studies examine the changes in spreads, Sarno and Taylor (1999) represent the most comprehensive empirical paper on creditor moral hazard in that they examine the time series properties of various financial flows (portfolio, commercial bank, official, and foreign direct investment, FDI, flows) to emerging markets. They argue that the knowledge about these properties would enhance one's predictive ability as to which types of flows are likely to be reversed. Their results indicate that official flows tend to have a large, statistically significant permanent component. Regarding private flows, FDI and commercial bank credits to East Asia have a large permanent component and therefore are highly irreversible, while portfolio flows to most Asian countries have a large temporary component. Such high degree of portfolio flow reversibility, among other findings, persuades Sarno and Taylor (1999) to conclude that their results regarding portfolio flows are consistent with the moral hazard interpretation of the East Asian crisis.

Other empirical studies of creditor moral hazard examine changes in spreads on emerging market bonds. Even though there is a significant body of literature on the determinants of spreads on emerging market bonds, only a few studies directly relate changes in spreads to moral hazard.[1] The following studies examine the changes in spreads before, during, and after the currency crises of the 1990s. It is generally assumed that declining yield spreads may imply creditor moral hazard.

Kamin and Kleist (1999) show that the fundamental relationship between the credit rating of selected emerging countries and spreads on their bonds was intact during the Mexican crisis. The coefficient of the interaction term between the Mexico dummy

and the credit rating variable is found statistically significant, indicating that lower creditworthiness was associated with higher spreads during the Mexican crisis. Kamin and Kleist (1999) also show that spreads are lower after the Mexican crisis.[2] However, they attribute this result to the overall improvement of emerging markets' fundamentals following the crisis, and not to moral hazard.[3]

Zhang (1999) focuses on Eurobonds and Brady bonds spreads and reports higher spreads during the Mexican crisis, which is consistent with the finding in Kamin and Kleist (1999).[4] Zhang (1999) argues that his finding of a positive and statistically significant coefficient on U.S. high-yield bond spreads does not only provide support for the capital market segmentation hypothesis, but also reinforces the above result regarding the absence of creditor moral hazard in bond markets. He argues that, if there were creditor moral hazard due to the financial support provided to Mexico, funds would have been taken away from U.S. high-yield bonds towards emerging market bonds, which would have produced a negative coefficient.

Our approach is closely related to that of Lane and Phillips (2000). They adopt a news-based approach to observe the effects of IMF-related news on spreads, using the EMBI.[5] They conclude that news regarding the Fund's support to Mexico, Thailand, Indonesia, South Korea, and Russia generally increased yield spreads on emerging country debt, which is not consistent with creditor moral hazard. Additionally, they point out that IMF-packages are not large enough to provide guarantees for the majority of investors.

Tillmann (2001) estimates spreads by means of a GARCH-in-the-mean (GARCH-M) model, and finds that investors of emerging market bonds charge a higher risk

premium when the degree of market uncertainty rises. Therefore, creditor moral hazard changes the risk-return relationship by decreasing the unit price of perceived risk. Tillmann's (2001) results show that, in one specification, the coefficient of the crisis dummy has the sign that is consistent with creditor moral hazard, but it statistically insignificant.

Dell'Ariccia, Schnabel, and Zettelmeyer (2002) argue that the recent Russian crisis is much better suited to test the impact of changing bailout expectations on spreads than the 1995 Mexican bailout, because it represents a highly unanticipated non-bailout event. They find that the Russian crisis was followed by a permanent and significant increase in spreads, indicating that the Russian non-bailout increased the perceived risk of emerging market debt. Their results suggest that spreads became more responsive to country ratings after the Russian crisis, which is not consistent with the creditor moral hazard hypothesis.

Finally, Kamin (2002) shows that both the Mexican and Russian crises led to statistically significantly higher spreads. Kamin (2002) recognizes that spreads are affected by both supply and demand conditions and it is difficult to attribute changes in spreads to either condition. He adds that his results regarding capital flows to emerging market economies are consistent with the changes in relevant countries' fundamentals, indicating no creditor moral hazard.

Evaluation of the Existing Literature

The literature review suggests that, except for Sarno & Taylor (1999), other studies find no creditor moral hazard effects in bond markets. In addition, the procedures of Sarno and Taylor (1999) do not directly measure creditor moral hazard. They simply

show which types of flows are more likely to be associated with creditor moral hazard. One can therefore argue that the accumulated empirical evidence so far does not provide significant support for creditor moral hazard in bond markets.

Previous results may be sensitive the type of data and news used, as well as the treatment of investor behavior. With respect to the type of data, all earlier studies, with the exception of Sarno and Taylor (1999), use some variation of the EMBI. Latin America's debt instruments, especially Brady bonds, have an overwhelming weight in the EMBI. Both Figure 1 and Table 2 show the strong representation of the Latin American debt in the EMBI. Even though between April 1991 and October 2001 non-Latin debt increased its share from zero to almost 33 percent, the EMBI is still influenced by the Latin American debt. Additionally, Figure 1 indicates that the EMBI was heavily influenced by the Latin American debt during the mid- and late-1990s, which are the years of interest in this paper. The problem with choosing the EMBI spreads is that the changes in spreads may not contain information regarding creditor moral hazard with respect to non-Latin American countries. We think that using country-specific data is more useful for correct inferences.

Regarding the use of IMF program dummies in regressions to make inferences about creditor moral hazard, there are three significant issues. The first one is related to the duration of the crisis dummy. In studies by Zhang (1999), Kamin and Kleist (1999), Dell'Ariccia et al. (2002), and Kamin (2002), this variable covers the entire IMF program period. It is questionable whether creditor moral hazard would last as long time as a couple of years. We believe that creditor moral hazard should last for a shorter time due to the highly reversibility of equity flows. Indeed, Hayo and Kutan (2003) report that the

effects of IMF-related news are neutralized in stock, bond, and foreign exchange markets within one day after the announcement. Clearly, one should choose a shorter horizon for testing creditor moral hazard in these markets. It is possible that creditor moral hazard may not be present when a longer horizon is used.

The second issue the selection of most relevant IMF-related news for moral hazard tests. Because of the highly reversible nature of portfolio investment, we argue that, besides program implementation, investors would pay attention to information contained in news such as start of IMF program negotiations or a final program approval, showing the amount of expected Fund supports over time.

Third, because of the sequential nature of the 1990s currency crises, some economists have suggested the presence of sequential moral hazard. According to this view, an IMF support in country A may motivate investors to purchase country B's bonds and equities, if country B is expected to receive an IMF program in the near future as well (Edwards, 1998; Eichengreen, 2000; Feldstein, 1998; Friedman, 1998; Schultz *et al.*, 1998; Schwartz, 1998). Therefore, when testing for creditor moral hazard in a program country, besides IMF news in this country, news in other prospective countries should also be included in estimations to control for sequential moral hazard effects. Otherwise, inferences may be biased if other country news affects local equity returns.

Finally, investor behavior is not discussed thoroughly in previous studies. Creditor moral hazard is driven by investor behavior because it implies that investors undertake excessive risks, based on their expectation of an IMF program in a given country. Therefore, the process during which investors may decide to take such excessive risks during IMF programs should be explicitly described.

Our theoretical approach in this paper is based on a unified framework in that it addresses all the key issues summarized above: highly reversible nature of portfolio flows (Sarno and Taylor, 1999), spread determination (Kamin & Kleist, 1999; Zhang, 1999; Tillmann, 2001; Dell'Ariccia, Schnabel, and Zettelmeyer, 2002), a news approach (Lane & Phillips 2000), and Friedman's (1998) focus on investor behavior. In addition, we pay close attention to time series properties of bond spreads in estimations. While all previous studies, except for Tillmann (2001), employ OLS estimates of bond spreads, we also use the maximum likelihood GARCH models to account for time-varying volatility in bond spreads.

3. A Unified Framework

In this section, we model investor behavior. We like to answer the question of why investors would decide to hold more of a country's financial instruments in the presence of a prospective IMF program in that country. Noting the fact that emerging markets issue high-risk, high-return bonds, we expect that investors would include more of these instruments, if IMF programs would signal implicit guarantees on their (high) returns. The nature of the implicit guarantees with respect to portfolio flows depends upon the type of financial flows.[6] When sovereign bonds are considered, it can be argued that defaulting on its sovereign bonds would be damaging to a country's creditworthiness. Especially when the country is currently under an IMF program and trying to signal improvement, stability, and credibility, it would be less willing to default on its sovereign bonds. Additionally, there is the issue of the currency denomination of the financial instrument, based on which the nature of the implicit guarantee would

change. Instruments denominated in domestic currencies are subject to exchange rate risk, which requires the explanation of investors' expectations regarding the effect of IMF programs on the exchange rate.[7] In this paper, we focus on dollar-denominated sovereign bonds, as the majority of the existing literature does.

Now, we turn our attention to the characteristics of investors. There is a wide variety of assumptions regarding investor behavior: rational behavior, limited rational behavior, noise traders, contagion, etc.[8] We assume rational agents. This implies that agents will revise their current information and subsequently their decision as more information becomes available to them. We rule out "mimetic contagion" and assume that an investor's decision does not contain any information to another investor (Topol, 1991).[9] This enables us to explain the nature of creditor moral hazard based on the representative agent framework.[10]

We assume competitive, risk-neutral lenders. The spread over the risk-free interest rate implies the default probability of country i, δ_i, which is a function of the country's fundamentals, X_i. Therefore, the ex-ante gross lending rate in country *i*, R_i, can be expressed as a function of the exogenous gross risk-free interest rate, R^*, and the default probability, δ_i.

$$R_i = \frac{R^*}{1-\delta_i} \qquad (1)$$

Even if a country defaults on its debt, some portion of its debt payments may be recovered. Whether and to what extent the recovery would take place depends upon the

perceptions and decisions of lenders and borrowers. Lenders could recover their investment, among other things, if the country receives funds from the IMF, and if the borrowing country decides to use some portion of the financial assistance provided by the IMF to make recovery payments to the holders of its sovereign bonds in an attempt to prevent further decline in the country's creditworthiness. The probability that the IMF will provide financial support to country i, ϕ_i, is determined by the IMF. The proportion of publicly guaranteed bonds that will be recovered in the event of default, ρ_i, is determined by the country i's government.[11] We assume that the decisions of IMF regarding the supply of a program and the decisions of the borrowing government regarding the use of IMF funds for recovery payments are made independently from each other.

We assume that the risk-free interest rate is determined as follows:

$$R^* = R_i\left[1-\delta_i(1-\phi_i\rho_i)\right] \qquad (2)$$

As long as $\phi_i\rho_i\langle 1$, only a portion of the loss due to default is recovered. The spread can be expressed as

$$s_i = R_i - R^* = R^*\frac{\delta_i(1-\phi_i\rho_i)}{1-\delta_i(1-\phi_i\rho_i)}. \qquad (3)$$

Based on Equation (3), there is a negative relationship between the spread and the probability of IMF-support. As the probability of IMF-support increases, the spread on

publicly guaranteed bonds declines, holding both the country's fundamentals and the fundamentals in the industrialized country constant (Equation 3).

$$\frac{\partial s_i}{\partial \phi_i} = -R^* \frac{\delta_i \rho_i}{\left[1-\delta_i\left(1-\phi_i \rho_i\right)\right]^2} \langle 0 \qquad (4)$$

The above discussion establishes a negative relationship between the probability of an IMF-support and spreads. This relationship may imply creditor moral hazard, because the IMF-support provides the program country with funds part of which may be used by the recipient county to make payments to the holders of its sovereign bonds.

At this point, we discuss the question of how investors would respond to IMF-related news and what they would expect during the duration of an IMF program. With respect to IMF-related news, we consider two types of news that are most relevant for moral hazard: announcement of program negotiations and program approval. We assume that investors interpret such news based on available information regarding the past and current economic performance of the relevant country. Once the start of program negotiations with a country is announced, it is important for investors to attach some probabilities to program approval. It is fairly rare that the IMF decides not to provide a program to a country at the end of negotiations. Therefore, once negotiations start, investors may believe that the country will receive IMF support with a very high probability. However, when negotiations start, it is assumed that investors do not know about the size of the program. This particular information, the amount of IMF support, is generally provided when a program is approved. The amount of IMF support is of relevance to investors who consider purchasing sovereign bonds of the program country,

because larger IMF support would increase the ability of the government to service its debt payments. Investor expectations regarding the country's economic performance during the IMF program are important as well. It could be argued that rational investors expect a slower economy in the program country during the implementation of an IMF program, given the evidence that GDP growth rates tend to decline during IMF program years (See Evrensel , 2002 and Prezeworski and Vreeland , 2000).

In addition to the program country's own IMF-related news, it is important to consider IMF-related news in other prospective countries to control for sequential creditor moral hazard. Investors may use information contained in IMF programs provided to other emerging countries as an additional piece of information to recalculate the probability of an IMF program in an emerging country. Suppose investors have certain views on relevant emerging countries' debt instruments, including country *i*'s instruments (say, Indonesia), before the news about a possible IMF-program in country *j* (say, Thailand) appears. The news about country *j* receiving an IMF program may motivate investors to revise their stand on emerging markets in general and on country *i*'s economic situation in particular. Suppose, based on revised market views initiated by the IMF-related news in country *j*, investors conclude that country *i* would be the next country to receive an IMF program, which would motivate investors to buy country *i*'s sovereign bonds.

Based on these considerations, our spread estimations include IMF-related news that contain program negotiations and program announcements associated with the country in question and other related countries. We consider the following regression equation regarding the spread, suppressing time subscripts:

$$s_i = X_i\alpha + \lambda US + IMF_i\beta + IMF_j\varphi + D_i\phi + \varepsilon_i \qquad (5)$$

where s_i represents the change in bond spreads in country *i*. Equation (5) suggests that, in addition to country *i*'s fundamentals (X), changes in spreads are affected by the spreads on U.S. high-yield corporate bonds (US), because such bonds may be related to emerging countries' debt instruments.[12] With respect to IMF-related news, we use (0,1) dummy variables, capturing the program country's own and other countries' IMF-related news. First, we consider the effect of IMF-related news in country *i* on this country's spread, which is captured by β. In addition to dummies indicating the start of negotiations and approval of a program in country *i*, we include an uncertainty variable, which we call "window", that captures the uncertainty about the outcome of negotiations during the time period between the day after the announcement of negotiations and the day before the program announcement. Second, we consider the effects of country *j*'s IMF-related news on country *i*'s spreads, which is captured by φ. We use the same negotiation-, approval-, and window-dummies associated with IMF-related news in country *j*. Finally, a dummy variable program for program duration (D) is included to capture the changes in spreads during an IMF program.

We now summarize the expected signs of the coefficients in Equation (5) in the presence of creditor moral hazard:

(i) The interpretation of the vector of coefficients that determine spreads depends upon the selected fundamentals. Because we use daily spread data, available daily variables that can be used as fundamentals are limited to exchange rates (E) and stock returns (SR).

In this case, we expect $\frac{\partial S_i}{\partial SR_i}\langle 0$ and $\frac{\partial S_i}{\partial E_i}\rangle 0$. The expected negative relationship between spreads and stock returns rests on the fact that stock returns contain information about the overall economic performance. Therefore, we expect that higher stock returns are associated with stronger overall economic performance, which should be associated with lower spreads. However, it is also possible that the relationship between bond spreads and stock returns reflects asset substitution, in which case one expects a positive relationship. The relationship between spreads and the exchange rate (defined as the amount of domestic currency per U.S. dollar), is expected to be positive because, for example, a depreciating currency may be the consequence of expansionary monetary policy, which in turn may be associated with expansionary fiscal policy. Clearly, fiscal and monetary policies that produce higher price levels and lead to currency depreciation do not signal economic strength and should be associated with higher spreads.

(ii) As Zhang (1999) suggests, in the presence of creditor moral hazard in bonds markets, the coefficient reflecting the relationship between US corporate bonds and emerging market bonds should be negative. Therefore, in the presence of moral hazard, it is expected that $\lambda < 0$. If $\lambda > 0$, this would indicate that emerging market and US corporate bonds have a complementary relationship.

(iii) In the presence of moral hazard, the coefficients of IMF-related news dummies in countries *i* and *j* are expected to be negative, given the countries' fundamentals ($\beta < 0$ and $\varphi < 0$). The program duration dummy may be insignificant due to several reasons. Among them, even though previous studies expected a negative sign on the coefficient of the duration dummy, ϕ, in the presence of moral hazard, there is evidence that the overall economic performance weakens during an IMF program (Evrensel, 2002;

Prezeworski and Vreeland, 2000). Additionally, considering the fact that programs last at least one year and portfolio flows are highly reversible, it is questionable whether creditor moral hazard would be present during the entire duration of an IMF program.

4. Empirical Analysis

We use daily bond spreads data of Indonesia and Korea. The sample period is dictated by data availability. For Indonesia, it runs from 12/19/1996 through 2/27/2003, while for Korea it is from 5/17/1996 through 2/27/2003. Countries' spreads and US corporate bond spreads are expressed in percentage**.** For consistency, fundamentals such as exchange rate and stock market prices are also computed as percentage changes in these variables, using the log-differenced series, multiplied by 100. Data are obtained from DataStream.

Although data are available for Thailand, we do not include this country in our analysis as the dependent variable due to the (sequential) nature of our framework, because Thailand was the first country in the East Asia to experience a financial crisis. However, we include IMF-related announcements regarding Thailand in our estimations of the Indonesian and Korean bond spreads. Table 3 reports the dates of program negotiations and approvals, along with the duration of programs.

Table 4 summarizes the results of our empirical analysis. We use dummy variables regarding announcements of negotiations and program approval. These variables take a value of 1 at the day that negotiations begin ("negotiations") and the day in which a program approval is announced for each country ("approval"), respectively. We include another dummy variable that captures the uncertainty about the outcome of

negotiations. This variable is called "window" and takes a value of 1 during the time period from the day after the negotiations announcement until the day before the program announcement. Estimation also included lagged spreads to account for autocorrelation and a dummy variable to account for the prolonged volatility in spreads due to the turmoil during the financial crisis in Indonesia and Korea that lasted until the mid-1998s. These results are not reported in Table 4 for space considerations, but available upon request.

Table 4 contains the OLS and GARCH estimations of sovereign bond spreads in Indonesia and Korea. The fact that the majority of the previous studies employ OLS estimations of bond spreads and because we found significant ARCH effects in bond spreads (see the diagnostic tests in Table 4) motivated us to use this method to provide maximum likelihood GARCH(1,1) estimates of spreads as well. For Indonesia, the ARCH effects are found only at longer lags, suggesting long-term memory. These results are confirmed in Table 4, as the estimated ARCH coefficients for Indonesia are insignificant, the GARCH term is. For Korea, ARCH effects appear at much shorter lags, as confirmed by the significance of the ARCH term.

In the following, we report the statistically significant results of our empirical analysis, unless indicated otherwise.

Impact of Fundamentals

In terms of spread determination in period *t*, we use current US corporate bond spreads and one-period lags of exchange rates and stock returns. The latter is important to remove the simultaneity bias. In all specifications, the coefficients on the US corporate bond spread variable in both Indonesia and Korea are significant and positive, indicating

a complementary relationship between emerging and industrialized country high yield-high risk debt instruments. The results verify those provided by Zhang (1999).

As expected in the previous section, there is a positive relationship between spreads and exchange rates both in Indonesia and Korea, indicating that depreciations of the domestic currency increase sovereign bond spreads. This result is consistent both in OLS and GARCH specifications shown in Table 4.

The relationship between spreads and stock market returns, however, is sensitive to the estimation method employed. As discussed in the theoretical section, the association between spreads and stock returns may be interpreted as an indication of overall economic performance or asset substitution. In Table 4, OLS estimates of the Indonesian spreads indicate a positive relationship between spreads and stock returns. For the Korean spreads, GARCH estimations imply a positive relationship between spreads and stock returns. Therefore, the results suggest the asset substitution interpretation of the bond spreads-stock returns relationship.

Overall, our results demonstrate the ability of economic fundamentals, especially US corporate bond spreads and exchange rates, in explaining spreads during the sample period.

Spreads and IMF announcements: Indonesia

Thailand-related news, especially the announcement of program approval in Thailand, increases the Indonesian bond spreads. Additionally, the Indonesian spreads did not experience statistically significant changes during the Thai window. These results do not support the sequential moral hazard hypothesis. In the presence of sequential

moral hazard, we would have observed a statistically significantly lower spreads in Indonesia due to IMF-related announcements in Thailand.

When we consider Indonesia's own IMF-related news, both OLS and GARCH estimations in Table 4 imply similar results. On the days of the negotiation and program approval announcements, Indonesian spreads declined significantly, which is consistent with the moral hazard argument. The mean change in Indonesian spreads during the sample period was .0014 percent. The decline in spreads on the mentioned announcement days is quite above the mean. While the Indonesian spreads declined by .08 to .09 percent on the day of program negotiations, they declined by more than half a percent (.55) on the day of program approval.

During the Indonesian window, there is an increase in spreads, only when the GARCH model is employed, indicating uncertainty prior to the program approval. It seems that, even though investors may have been engaged in buying activity on the days of the negotiation and approval announcement, they may have been engaged in selling activity during the window.

The results regarding the duration dummy in the mean equation indicates that, once the program starts, average changes in spreads are not statistically significant. However, the duration dummy has a statistically significant positive sign in the conditional variance equation, indicating an increase in the volatility of spreads during an IMF program. Therefore, we can conclude that, even though changes in spreads are not statistically significant during an IMF program, spreads exhibit higher volatility.[13]

The reported Q and Q^2 tests statistics for the Indonesian estimations indicate that the estimated GARCH(1,1) models do not suffer from serial correlation and accounts for time-varying volatility up to 10 lags.

Spreads and IMF announcements: Korea

The results regarding Korea are similar to those obtained for Indonesia. The majority of IMF-related announcements regarding Thailand and Indonesia seem to increase the Korean bond spreads, suggesting that IMF involvement in Thailand and Indonesia was associated with larger spreads in Korea. While the Korean spreads experienced no change during the Thai window, they increased during the Indonesian window. Because there is no evidence that other countries' IMF-related announcements led to a decline in the Korean spreads, our results do not support the sequential moral hazard hypothesis for Korea.

Regarding Korea's own IMF-related announcements, the Korean spreads declined statistically significantly on the day of the announcements associated with Korean program negotiations and approval. Compared to the mean change in the Korean spreads during the sample period (.0005 percent), the decline in spreads on the mentioned announcement days are quite large. While spreads declined by .6 to .9 percent on the day of program negotiations, they declined by .12 to .22 percent on the day of program approval. During its own window, both OLS and GARCH results indicate no change in spreads.

The results regarding the significance of the duration dummy in the mean equation are sensitive to the specification used. While the change in spreads during the Korean program is not statistically significant in the GARCH model, OLS estimates

indicate statistically significantly declining spreads during the program. However, the evidence is marginal at more than 10 percent. The statistical significance of the duration dummy in the conditional variance equation indicates higher volatility in the Korean spreads. Finally, the reported Q and Q^2 tests statistics indicate that the estimated GARCH(1,1) models do not suffer from serial correlation and accounts for all time-varying volatility up to 10 lags.

Sensitivity Analysis

We experimented with other models to check the sensitivity of our results to different specifications. First, we ran some dynamic models, which included up to 5-day lags of both announcement dummies (program negotiation and approval). The results of the dynamic models did not indicate any statistically significant patterns in spreads before IMF-related news. This result is consistent with Hayo and Kutan (2003) who found similar results for the impact of IMF-related news on stock returns. Therefore, these results are not reported.

Next, given the evidence that the window variables in Table seem to be insignificant in most cases, we experimented with a model that excludes the window variable, but instead adds a pre-announcement dummy associated with program negotiations and approval. In this model, the uncertainty is assumed to last only one day, the day before a particular announcement. This variable also captures the possibility that the official announcement could have been leaked the day before the announcement. These results are shown in Table 5.

The results regarding the impact of all fundamentals in both Indonesia and Korea are quite robust. There is no change in inferences, except in one case for Korea. In this

new specification, the impact of stock returns on spreads becomes insignificant. The program duration dummy in the mean equation is still insignificant in both countries. The Korean duration dummy, however, becomes significant in the conditional variance equation.

We summarize the rest of the results starting with Indonesia first. With respect to the sequential moral hazard hypothesis, our pre-announcement model produces similar results to that with windows. The one-day lagged Thai negotiations and program approval either increase the Indonesian spreads or lead to no change in them. As before, there is no evidence for the sequential moral hazard in Indonesia.

When we consider Indonesia's own IMF-related news, pre-announcement models indicate a decline on the days of the negotiation and approval announcements, which are consistent with our previous results using models with windows. In most of the pre-announcement models, the change in spreads the day before the announcement of negotiations is significantly higher and may indicate some information leakage before the official announcement. The day before the program approval, spreads increase significantly as well, indicating uncertainty prior to program approval. However, the increase in spreads the day prior to the approval (.0464 percent) is more than ten times the decline in spreads on the day of the approval, still suggesting significant moral hazard effects.

Now, we turn to the results regarding Korea. With respect to the sequential moral hazard hypothesis, the negotiation and approval announcements in Thailand and Indonesia either do not lead to any changes in the Korean spreads or they lead to an increase in spreads. Only the one-day lagged Thai negotiations and the one-day lagged

Indonesian approval decrease the Korean spreads in OLS specifications, which may be consistent with the sequential moral hazard hypothesis. However, the results of the pre-announcement models do not suggest a strong sequential moral hazard effect in Korea.

With respect to the Korean news, the results of the pre-announcement models are consistent with those of window models. The Korean spreads decline on the days of negotiations and approval announcements in Korea. However, both OLS and GARCH results indicate a significant increase in the Korean spreads on the day before the negotiation announcement. Most pre-announcement results regarding program approval indicate that the Korean spreads were higher the day before the announcements of negotiations and program approval.

Overall, our sensitivity tests indicate that most of our results in Table 4 remain robust in alternative model specifications.

Discussion of Empirical Results

Compared to previous studies on creditor moral hazard in bond markets, our results demonstrate the advantage of using country-specific data and IMF-related dummies that do not only cover the program period, but also account for the changes in spreads due to IMF-related announcements. Considering the fact that previous studies use IMF-related dummies that last for the duration of IMF programs, it is plausible that they observe increasing spreads and conclude that creditor moral hazard in bond markets does not exist. However, our results suggest that countries' own IMF-related news decreased spreads in Indonesia and Korea, especially when the GARCH models are used, which indicates the possibility of creditor moral hazard in sovereign bond markets.

With respect to investor behavior, the results indicate that investors appear to be rational and use all available information to make a decision. Additionally, as Sarno and Taylor (1999) suggest, they move fast in bonds and equity markets. Our results indicate that, given their risk awareness and expected reduction in risk and increase in returns through IMF support, they may have purchased Indonesian or Korean bonds on the days of local (own-country) IMF-related announcements.

The reason as to why the own window news does not indicate any statistically significant activity in the Korean bond market but indicates higher spreads in Indonesia (when GARCH models are used) can be explained by the characteristics of announcements regarding program negotiations and approval, as well as investors' expectations regarding the relevant country's fundamentals. One can argue that, once negotiations start, countries receive an IMF program with a probability close to 1, which may be enough information for some investors to buy these countries' bonds. However, because of the fact that the size of the IMF program is not known and that there may be some publicized disagreements between the IMF and prospective program country during the negotiation period, we would observe a rather inactive window. On the day of the program approval, when the size of the program and program conditions are announced, some investors who wanted to have this particular information may have bought the prospective program country's bonds.

In the case of Indonesia, there was an additional element of risk: growing political and social instability. This, along with well-known close ties between the President and his family businesses in Indonesia probably made investors nervous about the ownership and implementation of IMF programs, causing higher spreads during the window period.

Program implementation was problematic in Indonesia. In addition to the pressures from the U.S. and the EU, regional powers such as Japan and Australia also intervened into the IMF-Indonesia relations. Korea, however, being one of the most robust emerging economies ever seems to have demonstrated more determination than Indonesia in the eyes of investors regarding the future implementation of their IMF program.

Our results indicate that investors seem to pay close attention to country-specific news. The extent of the decline in spreads on the day of the announcement regarding program negotiations and approval implies a clear pattern. As mentioned earlier, in Indonesia, the decline in spreads on the day of the announcement regarding program approval is five times larger than the decline in spreads on the day of the announcement regarding program negotiations. This indicates that, even though negotiations with the IMF generally lead to an IMF program, investors were not encouraged by the problematic IMF-Indonesia relations during the negotiation period until they finally know about the program approval and the size of the program.

In Korea, however, it was just the opposite. The decline in the Korean spreads on the day of program negotiations is about five times larger than the decline on the day of the announcement regarding program approval. The relative strength of approval-related news in Indonesia and negotiation-related news in Korea may lie in the fact that, while investor uncertainty regarding program approval in Indonesia was substantial, investors must have attached a greater probability to the program approval, once they heard the announcement regarding the start of negotiations in Korea.

Overall, the results show that investors are rational in the sense that they pay close attention to country-specific economic conditions and news. This result coupled with the

fact that they react to news very quickly implies that there is creditor moral hazard in bond markets, its duration can be measured by days. There are two additional piece of evidence we presented that further support why the duration of creditor moral hazard would be temporary. First, the observed decline in spreads in both Indonesia and Korea on the day of the negotiation announcement does not appear to persist and continue during the window period. Second, spreads do not appear to decline during an IMF program. Indeed, there is no significant change in the spreads during the program periods in both countries (except for Korea in OLS estimations). These empirical observations imply that creditor moral hazard, if it exists, can be best described as a short-run phenomenon, lasting only days.

5. Concluding Remarks and Suggestions for further Research

The existing literature on creditor moral hazard in bond markets finds no evidence of moral hazard associated with IMF programs in emerging countries. Our motivation stems from the belief that the approach adopted by previous studies can be improved. We have introduced a unified framework for testing creditor moral hazard in sovereign bond markets. Our empirical analysis uses the spreads on Indonesian and Korean sovereign bonds. We find no strong evidence for the sequential moral hazard hypothesis. In other words, news related to other countries' IMF announcements do not tend to decrease the relevant country's spreads.

Similarly, we do not find any strong evidence that program duration is associated with creditor moral hazard. In most specifications, spreads do not change during the implementation of IMF programs both in Indonesia and Korea. We do, however, find

evidence of declining spreads on the days of IMF-related announcements regarding program negotiations and approval, which may imply moral hazard. However, there are no significant declines in spreads following negotiation news during the window period prior to program approvals. Moreover, we observe significant increases in the spread the day before program approvals. These observations suggest that the duration of creditor moral hazard is quite short and may be measured only by days.

Regarding future research, more evidence from other episodes would be useful to make broader generalizations about investor behavior. In addition, the seemingly temporary nature of creditor moral hazard needs to be more investigated. We believe that the basic challenge to any creditor moral hazard study is the ability to distinguish between usual investor behavior that simply reflects typical reactions to news and investor behavior that implies moral hazard. As Friedman (1998) says: "…. I regard that (moral hazard) as something of a libel. If someone offers you a gift, is it immoral for you to accept it? Similarly, it's hard to blame private lenders for accepting the IMF's implicit offer of insurance against risk." The challenge for future studies is therefore to develop tests of creditor moral hazard that can better distinguish among different types of investor behavior.

NOTES

[1] Cline (1995), Cantor and Packer (1996), Cline and Barnes (1997), and Eichengreen and Mody (1998) are among the papers on the determination of bond spreads. Spread is defined as the difference in the yields of a risky and risk-free instrument of similar maturity and currency denomination. Most studies use the yield on U.S. Treasury bill or note as the yield on the risk-free debt instrument.

[2] This result is verified in Eichengreen and Mody (1998) as well.

[3] First, the fact that spreads on emerging market bonds have declined since 1996 can be explained by a possible learning experience by emerging market borrowers and by the implementation of various stabilization programs, especially in Latin America. In other words, declining spreads may be due to improving fundamentals. Second, because short-term interest rates in industrial countries declined as well, investors in these countries may have channeled funds toward emerging markets (Kamin and Kleist, 1999).

[4] While Eurobonds are short-term debt instruments, Brady bonds are long-term sovereign bonds that represent restructured sovereign commercial bank debt. During the early 1990s, the latter was virtually the only type of long-term sovereign bonds issued by emerging countries. Because the principle and interest on Brady bonds are partially collateralized, the countries that initially offered Brady bonds now issue uncollateralized debt with spreads that are frequently lower than the ones on outstanding Brady bonds. As Kamin and Kleist (1999) suggest, the disinclination to pay higher transaction costs associated with collateralization may have lowered the demand for such bonds. Still, Brady bonds are the single most-traded emerging market debt instruments with transactions of $2.7 trillion in 1996. The sharp increase in the turnover of Brady bonds (from $1 trillion in 1993 to $2.7 trillion in 1996) relative to a modest increase in the stock of such bonds suggests that there has been a substantial increase in their liquidity. Furthermore, because Latin American issues represent a substantial proportion of outstanding Brady bonds, most emerging market bond indices largely reflect Latin American Brady debt (IMF, 1996).

[5] The EMBI includes 21 emerging economies' dollar denominated debt. Brady bonds have a weight of 91 percent in EMBI (IMF, 1996).

[6] See Evrensel and Kutan (2004) for the framework of creditor moral hazard in emerging countries' stock markets.

[7] Investors would know that IMF programs attempt to implement a stabilization program that suggests, among other things, the depreciation of the currency. Empirical studies suggest that, among other things, prescribed depreciation of domestic currencies has not been successfully implemented during IMF programs (Evrensel, 2002). In an attempt to avoid the currency risk, investors may focus on financial instruments of emerging markets denominated in foreign currencies.

[8] Noise traders who react in concert to non-fundamental signals are thought to influence equilibrium asset prices. Because price deviations from fundamentals created by changes in investor sentiment are unpredictable, noise traders introduce a systematic risk that is priced. See French, Schwert, and Stambaugh (1987), De Long, Shleifer, Summers, and Waldmann (1990), Brauer (1993), Brown (1999), and Lee at al. (2002) for theoretical and empirical treatment of noise traders.

[9] Topol's (1991) model assumes that an investor sets his bid or ask price according to an additive learning process. Investor adjusts his prices to his present value calculated from an incomplete information set. Additionally, to capture some information held by the other investors, he also adjusts his prices to average prices of his nearest buyers and sellers, which implies "mimetic contagion."

[10] If agents have imperfect information and mimetic contagion exists, mean and variance of financial instruments' prices are simultaneously determined, which implies that it is no longer possible to explain the price dynamics based on one agent's statistical properties. The representative agent hypothesis becomes invalid (Topol, 1991).

[11] It is possible to further define the relationship between the default probability, country fundamentals, and IMF-support. One can assume, for example, that default probability is a function of the country's fundamentals, and IMF programs influence these fundamentals. If IMF-support improved a country's fundamentals, it would reduce the default probability, which would imply $\partial \delta_i \left(X_i, \phi_i \right) / \partial \phi_i < 0$. We assume away these relationships for two reasons. First, such relationships are essentially about program effectiveness, and not about creditor moral hazard. Second, the relationship between IMF-support and the country's fundamentals (and therefore default probability) may not be a contemporaneous one. It is likely that there is a lag between the start of the IMF-support and its effects on the country's economy.

[12] This spread implies the difference between the yield on a U.S. high-yield corporate bond and Treasury bill.

[13] We also attempted to include IMF-related news in the variance equation; however, the results were not reliable in the sense that we were not able to get convergence in the estimations.

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Figure 1: Latin and non-Latin components of the EMBI

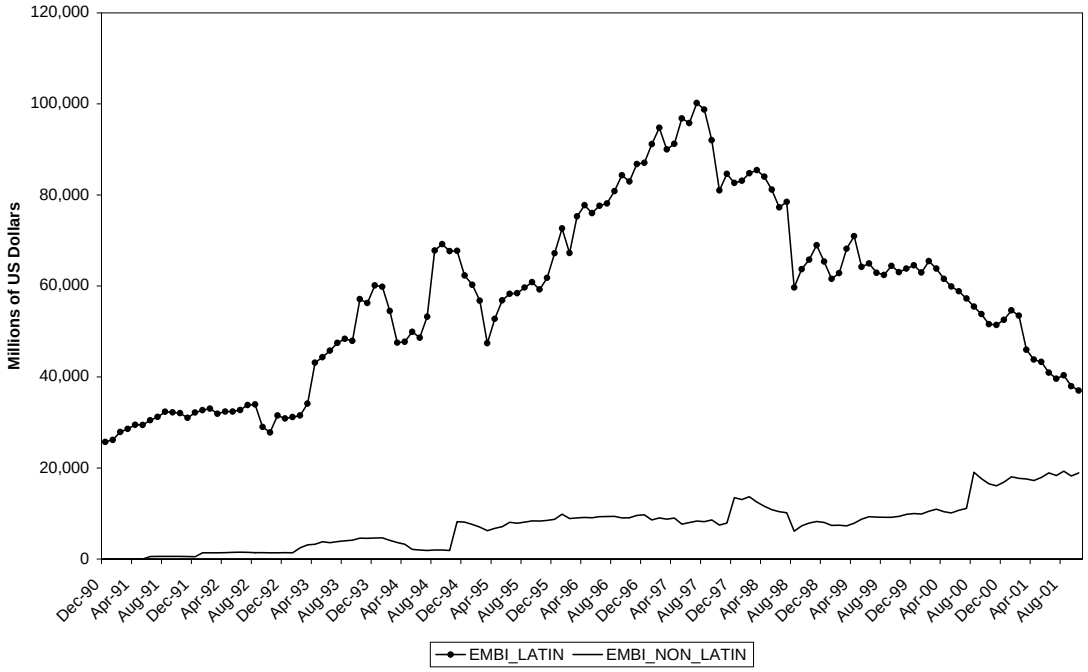

Table 1: Overview of empirical studies on creditor moral hazard

Author(s)	Type of the credit instrument	Country/Region/Data	Method used	Indication for creditor moral hazard	Evidence for creditor moral hazard [1]
Sarno & Taylor (1999)	Portfolio (equity & bonds) Commercial banks FDI Official lending	Australia, China, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand	Testing for permanent and temporary components in capital flows	Large temporary component in portfolio flows	Yes, especially with respect to portfolio flows
Zhang (1999)	Bond	Argentina, Chile, China, Colombia, Hungary, Mexico, Philippine, Venezuela	Regression (dependent variable: emerging market bond spreads)	Higher spreads during and after the Mexican crisis	No evidence
Kamin & Kleist (1999)	Bond	EMBI	Regression (dependent variable: emerging market bond spreads)	Higher spreads during the Mexican crisis	No evidence
Philipps & Lane (2000)	Bond	EMBI & news about Mexico, Thailand, Korea, Indonesia, and Russia	Observation of the effects of IMF-related news on spreads	Higher spreads due IMF-related news	No evidence
Tillmann (2001)	Bond	EMBI & news about Mexico, Thailand, Korea, Indonesia, Russia, and Brazil	Markov-switching GARCH-M	Declining price of risk associated with IMF-related news	Inconclusive
Dell'Ariccia, Schnabel, and Zettelmeyer (2002)	Bond	EMBIG [2]	Regression (dependent variable: emerging market bond spreads)	Higher spreads, higher responsiveness of spreads to fundamentals, and greater variance in spreads after the Russian crisis	No evidence

Table 1 cont'd

Author(s)	Type of the credit instrument	Country/Region/Data	Method used	Indication for creditor moral hazard	Evidence for creditor moral hazard [1]
Kamin (2002)	Bond	EMBI	Regression (dependent variable: emerging market bond spreads)	Higher spreads after the Mexican and Russian crisis	No evidence

[1] Evidence or no evidence entry refers to the relevant author's (s) interpretation of his/her results.
[2] EMBIG refers to J.P. Morgan's Emerging Market Bond Index Global that contains secondary market bond spreads.

Table 2: Country-specific and regional representation in the monthly EMBI (Dec 1990 – Oct 2001)

Country	Mean	Min	Max
Argentina	14.61 [1]	0.00	31.40
Brazil	24.94	1.73	40.66
Ecuador	1.92	0.00	4.30
Mexico	31.73	12.20	70.62
Nigeria	1.36	0.00	2.76
Panama	1.10	0.00	3.53
Venezuela	13.81	6.26	27.65
Latin	**89.34**	**67.57**	**100.00** [2]
Bulgaria	2.43	0.00	6.48
Philippines	1.41	0.00	5.94
Poland	3.20	0.00	6.10
Russia	2.29	0.00	18.67
Non-Latin	**10.66**	**0.00** [1]	**32.43** [3]

[1] Numbers indicate the relevant countries' percent share in the EMBI.
[2] Until April 1991, the EMBI consisted of Latin American debt.
[3] As of October 2001, non-Latin debt accounted for almost 33 percent of the EMBI.

Table 3: Dates associated with IMF-related news and program duration [1]

	Thailand	Indonesia	Korea
Announcements associated with IMF programs [2]			
Start of negotiations	08/05/97	10/08/97	11/21/97
Program approval	08/20/97	11/05/97	12/04/97
Program duration [3]			
Effective date	08/20/97	11/05/97	12/04/97
Expiration date	06/19/00	11/04/00	12/03/00

[1] The term "program" implies standby arrangements.

[2] Dates associated with IMF-related announcements are based on Lane and Phillips (2000).

[3] *Annual Report* of the IMF in 1998 and 1999 provides the duration information. Effective and expiration dates imply the start and the end of a program respectively.

Table 4: Estimations of sovereign bond spreads of Indonesia and Korea: models with window

	INDONESIA [1]		KOREA	
	OLS	GARCH(1,1)	OLS	GARCH(1,1)
Constant	-.0054 (.2893)	-.0136 (.0466)	-.0016 (.5517)	-.0007 (.7332)
US corporate spreads	1.6163 (.0000)	1.4252 (.0000)	.7126 (.0000)	.7309 (.0000)
Exchange rate (-1)	.0109 (.0496)	.0115 (.0463)	.0386 (.0006)	.0078 (.0766)
Stock returns (-1)	.0096 (.0803)	.0056 (.1524)	-.0015 (.5014)	-.0016 (.0806)
Thailand negotiations	.0098 (.0831)	.0059 (.6759)	.0077 (.3029)	.0171 (.0001)
Window-Thailand	.0111 (.5803)	.0142 (.5305)	-.0009 (.9351)	.0034 (.7316)
Thailand Approval	.0803 (.0147)	.0768 (.0188)	.0758 (.0000)	.0711 (.0000)
Indonesia negotiations	-.0812 (.0000)	-.0807 (.0000)	.0015 (.8584)	.0025 (.6755)
Window-Indonesia	.0918 (.3563)	.0991 (.0925)	.0743 (.0371)	.0424 (.0102)
Indonesia approval	-.5438 (.0000)	-.5453 (.0000)	.3517 (.0000)	.2532 (.0000)
Korea negotiations			-.8517 (.0000)	-.5589 (.0000)
Window-Korea			-.0018 (.9841)	.0122 (.7119)
Korea approval			-.1186 (.0001)	-.2199 (.0000)
Program Duration	-.0149 (.2326)	-.0042 (.7747)	-.0106 (.1038)	-.0038 (.3195)
Variance equation				
Constant		.0118 (.0285)		.0002 (.0092)
ARCH(1)		.2084 (.2753)		.2154 (.0000)
GARCH(1)		.5467 (.0002)		.7846 (.0000)
Program Duration		.0139 (.0856)		.0001 (.2242)
Log likelihood Q(10) Q^2(10)		110.7215 6.2051 (.8594) .6088 (.9999)		1854.396 10.238 (.4236) 9.4321 (.4921)
Durbin-Watson F-statistic ARCH (35) test	2.07 6.07 (.0000) 55.8 (.0000)		2.06 16.42 (.0000) 876.1 (.0000)	
Sample period	12/19/96 – 2/27/03		5/17/96 – 2/27/03	

[1] The following information on country-specific bonds is provided in the order of issue year, interest rate, and maturity date: Indonesia, 1996, 7 ¾ percent, 08/01/06; Korea, 1996, 7 ¼ percent, 05/15/06.

Table 5: Estimations of sovereign bond spreads: models with pre-announcement effects

	INDONESIA		KOREA	
	OLS	GARCH(1,1)	OLS	GARCH(1,1)
Constant	-.0032 (.5664)	-.0137 (.0266)	-.0009 (.7422)	-.0021 (.3841)
US corporate spreads	1.6145 (.0000)	1.3571 (.0000)	.7138 (.0000)	.7145 (.0000)
Exchange rate (-1)	.0109 (.0537)	.0109 (.0198)	.0405 (.0002)	.0096 (.0571)
Stock returns (-1)	.0095 (.0803)	.0053 (.1862)	-.0016 (.4573)	-.0013 (.1755)
Thailand negotiations (-1)	.0174 (.0671)	.0251 (.0022)	.0248 (.0001)	.0209 (.0471)
Thailand negotiations	.0076 (.2096)	1.5863 (.2805)	.0066 (.3831)	.1802 (.1235)
Thailand approval (-1)	.0207 (.3183)	.0256 (.1643)	-.0167 (.0183)	.0041 (.4138)
Thailand Approval	.0774 (.0192)	.0412 (.3334)	.0754 (.0000)	.0727 (.0000)
Indonesia negotiations (-1)	.0251 (.1442)	.0676 (.0543)	.0575 (.0000)	.0596 (.0000)
Indonesia negotiations	-.0834 (.0000)	-.0854 (.0000)	.0006 (.9426)	.2815 (.1937)
Indonesia approval (-1)	.0463 (.0002)	.0464 (.0003)	-.0917 (.0063)	-.1552 (.3262)
Indonesia approval	-.5435 (.0000)	-.5437 (.0000)	.3648 (.0000)	.2588 (.0000)
Korea negotiations (-1)			.6376 (.0000)	.2576 (.0000)
Korea negotiations			-.8718 (.0000)	-.5704 (.0000)
Korea approval (-1)			.1157 (.0005)	-.0326 (.1885)
Korea approval			-.1132 (.0001)	-.2159 (.0000)
Program Duration	-.0171 (.1756)	-.0075 (.6102)	-.0111 (.0921)	-.0029 (.4526)
Variance equation				
Constant		.0176 (.0037)		.0006 (.0001)
ARCH(1)		.2359 (.2193)		.3432 (.0000)
GARCH(1)		.3949 (.0000)		.5904 (.0000)
Program Duration		.0228 (.1002)		.0012 (.0014)
Log likelihood Q(10) $Q^2(10)$		56.5881 8.2329 (.6065) .7204 (.9999)		1792.404 12.533 (.2514) 8.8483 (.5472)
Durbin-Watson F-statistic ARCH (35) test	2.07 5.03 (.0000) 55.7 (.0000)		2.08 14.72 (.0000) 875.1 (.0000)	

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