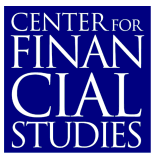

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Do Changes in Sovereign Credit Ratings Contribute to Financial Contagion in Emerging Market Crises?

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Do Changes in Sovereign Credit Ratings Contribute to Financial Contagion in Emerging Market Crises?

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Abstract:

Credit rating changes for long-term foreign currency debt may act as a wake-up call with upgrades and downgrades in one country affecting other financial markets within and across national borders. Such a potential (contagious) rating effect is likely to be stronger in emerging market economies, where institutional investors' problems of asymmetric information are more present. This empirical study complements earlier research by explicitly examining cross-security and cross-country contagious rating effects of credit rating agencies' sovereign risk assessments. In particular, the specific impact of sovereign rating changes during the financial turmoil in emerging markets in the latter half of the 1990s has been examined. The results indicate that sovereign rating changes in a ground-zero country have a (statistically) significant impact on the financial markets of other emerging market economies although the spillover effects tend to be regional.

JEL Classification: E44, E47, G15

Keywords: Sovereign Risk, Credit Ratings, Financial Contagion

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I Introduction

> *"Ninety percent of Mexicans have never heard of the Duma, and yet the exchange rate and interest rates that they live with every day were being driven by people with names like Kiriyenko and Chernomyrdin and Primakov."*[1]

A remarkable aspect of the financial market turbulences in the second half of the 1990s was the transmission of difficulties from one emerging market economy to others in the same region and, in some cases, even beyond. For instance, a prominent characteristic of the Asian crisis of 1997-98 was the degree to which it spread from Thailand to other countries in the region in only a few months. But the impact of the Thai financial crisis was not limited to the Southeast Asian economies. Financial markets in Latin America, Central and Eastern Europe, Russia and South Africa came under heavy pressure as a number of countries experienced large capital outflows in late 1997.

The international spillovers from the Russian crisis in August 1998 were even greater. Yield spreads for emerging markets' government bonds increased sharply, pressures on the currency intensified in many emerging market economies, and equity prices fell substantially in both emerging and mature markets. The INTERNATIONAL MONETARY FUND (2000) notes that the widespread flight to quality and the rush for liquidity led to a severe tightening of credit conditions not only for emerging market borrowers but also for non-prime borrowers in some mature markets. In spite of probable spillover effects resulting from common shocks, trade linkages or common creditors, a financial crisis can spread from one country to another because of information asymmetries in international financial markets. Indeed, as JEANNE AND MASSON (2000) emphasize, for some episodes such as the financial market pressure on Brazil following the sovereign default of Russia in mid-August 1998 it seems problematic to argue that trade linkages were the only, or even an important, transmission channel of financial market turbulences.

CALVO AND MENDOZA (2000b) have demonstrated that in today's globalized financial markets, utility maximizing investors with worldwide diversified portfolios will follow financial market conventions since carrying out comprehensive country-specific analyses and evaluations is too costly. In consequence, institutional investors may consider several

[1] This quotation is taken from a statement by Mexico's Secretary of the Treasury GURRÍA (1999).

emerging market economies in a specific region as substantially homogenous. A new piece of information concerning one of these emerging market economies may then be extrapolated and applied to the whole group of countries.

Country-specific events such as a negative sovereign credit rating announcement may be perceived as a "wake-up call" leading to a general reevaluation of investment conditions and prospects in the whole region, thereby inducing institutional investors to rebalance their portfolios. For instance, when a sovereign is lowered to speculative-grade, institutional investors who have positions in that country will usually choose to moderate their now increased risk exposure and will typically sell these financial instruments whose returns are highly volatile and positively correlated with those of the assets in the crisis-ridden country.[2] This aspect is imperative in emerging markets where investor confidence is not particularly strong. Moreover, investor's behavior is more volatile, given that some institutional investors are constrained to hold securities that have been classified as investment-grade by the credit rating agencies as a result of either official regulations or banks' internal risk management practices. Moreover, if a downgrading for one country provokes worries of a financial crisis somewhere else, institutional investors may expect to benefit from speculating against currencies that they think other market participants will shorten as well.

Previous research, for example REISEN AND VON MALTZAN (1999), MONFORD AND MULDER (2000) and KRÄUSSL (2003b), has not investigated whether sovereign rating adjustments for one country generate contagious fluctuations in financial markets in neighboring countries. Therefore, the following empirical analysis concentrates on this potential transmission channel of financial contagion by examining whether the occurrence of a sovereign credit rating downgrade in a particular emerging market economy at a given point in time is associated with the incidence of a financial market crisis in another country at the same point in time. In contrast to the recent analysis by KAMINSKY AND SCHMUKLER (2002), this empirical study examines not only implemented sovereign credit rating changes, but also imminent rating actions by the agencies, such as credit watches and rating outlooks.

The reminder of the paper is organized as follows. Section II explores the role of credit rating agencies in international financial markets. Section III gives an overview of the concept of financial contagion in emerging markets and discusses the underlying hypotheses of the

[2] This happens because uniformed investors do not know whether the changes of demand within a financial market following a shock are due to the hedging of macroeconomic risk across financial markets or due to informed investors trading on private information within the financial market (see CALVO AND MENDOZA (2000b)).

empirical study while Section IV presents the methodology and database. In particular, two different methodologies have been applied for studying potential contagious effects of sovereign credit rating changes in one country on other countries. First, event studies are employed to get an idea of any possible dynamic effects after the agencies' sovereign credit rating actions, and then panel regressions are estimated to get a sense of probable contemporaneous effects following the changes in the sovereign credit ratings. Section V presents the empirical results. Section VI concludes and offers an outlook.

II The Role of Credit Rating Agencies in International Financial Markets

Credit rating agencies provide standardized evaluations of the likely risks and returns associated with alternative investments according to standardized creditworthiness categories. They assign credit ratings for the purpose of generating information about default probabilities that are pertinent for pricing and hedging risky fixed-income securities of corporate, municipal and sovereign issuers. Credit rating agencies supply market participants with a system of relative creditworthiness of all bond issues by incorporating all the components of default risk into a single code: the credit rating. However, the choice concerning the investments to be undertaken remains with the investor. The cost of producing such information is imposed through fees on the issuers of rated securities and is not related to sales of particular financial products.

The agencies interpret their sovereign credit ratings as forward-looking indications of the relative risk that a sovereign debt issuer will not have the ability and willingness to make full and timely payments of principal and interest over the life of a particular rated financial instrument. Sovereign credit risk analysis may be divided into two broad components, specifically economic and political risk. Economic risk deals with the government's ability to repay its obligations on time and is a function of both qualitative and quantitative factors, while political risk addresses the sovereign's willingness to repay its outstanding debt on time.

For assigning their sovereign credit ratings the agencies apply an ordinal scale. Standard & Poor's (S&P) ratings for long-term foreign currency bonds run from AAA, the highest, through AA, A, and BBB, and then all the way down to CC. Similarly, the sovereign credit ratings assigned by Moody's Investors Service' (Moody's) range from that the sovereign is fairly unlikely to default (Aaa) down to that it has a relatively high risk of

default (C). Sovereign credit ratings are also subject to refinements. S&P's sovereign credit ratings from double-A to triple-C may be modified by the addition of a plus or a minus to show their relative standing within the major rating categories. Moody's applies for this reason numerical modifiers 1, 2 and 3 in each rating category from double-A to Caa.

In recent years, both S&P and Moody's have supplemented their credit risk assessments with credit watches and rating outlooks, respectively, designed to indicate the credit rating agencies' perspectives on developments that might induce a rating change. MOODY'S INVESTORS SERVICE (2001) mentions that it is crucial to discriminate between a credit watch and a rating outlook. Both are intended to communicate the agencies' credit opinion to the market participants, but each contains different information and has separate rating implications. Credit watches are part of the formal committee-based rating process by which the agencies' credit ratings are assigned, monitored and changed over time. In contrast, as the agencies emphasize, a change in the rating outlook is neither a rating change nor a review for a potential credit rating change. Therefore, a rating outlook may be considered as a useful early indicator, but as a weaker signal than a credit watch.

Credit ratings are often separated into two broad categories, i.e., investment-grade and speculative- or non-investment-grade. MERRILL LYNCH (1999) mentions that investment-grade issues are typically considered to be appropriate investments for institutional investors. S&P's issues rated BBB– and above are investment-grade, while Moody's split is made at Baa3. This differentiation has an essential role for institutional investors since the majority of them operate within restrictive limitations on the risk of financial instruments in their portfolio. In some cases these are absolute constraints: a manager of an investment-grade bond portfolio may be precluded from trading bonds that are not classified as investment-grade.

As a consequence, a sovereign credit rating upgrade to investment-grade is vital since it opens up a much wider investor base by making the bonds appropriate for enclosure in benchmark investment-grade indexes. This implicates that the sovereign credit rating upgrade will result in both increased and more stable demand for bonds of that particular emerging market. On the other hand, when an issuer receives a credit rating below-investment-grade, the number of potential investors radically declines. However, such a credit rating-effect is to some extent incorporated into the pricing of the country's debt concurrently with the news that the sovereign credit rating will be placed on review for a possible upgrade. This reflects the demand both from investment-grade portfolio managers that have some flexibility to make

allocations to non-investment-grade assets, and from unconstrained investors, for example high-yield portfolio managers and hedge funds. These institutional investors are able to purchase opportunistically and realize much of the prize impact of the credit rating upgrade and subsequently sell after the actual upgrade to other investors who have not had the flexibility to buy prior to the actual inclusion in investment-grade indexes.

Furthermore, through the so-called "sovereign ceiling", however, the sovereign credit rating has a major influence on the credit risk assignments for all other domestic entities. STANDARD & POOR'S (1997) and MOODY'S INVESTORS SERVICE (1999) record that until recently, the sovereign credit rating set a ceiling on the credit risk assessment that could be achieved by other domestic entities, under the assumption that the sovereign has the first claim on available foreign exchange reserves and controls the ability of any resident entity to get hold of international funds to compensate lenders.[3]

III Theory and Hypotheses

In order to formalize a definition of "financial contagion" it is necessary to distinguish four transmission mechanisms through which financial market crises might be propagated across countries. Firstly, several countries can be similarly affected by a common shock, such as an abrupt change in world interest rates. Secondly, trade linkages can spread a financial crisis, as a currency devaluation in one country weakens macroeconomic fundamentals in other countries by diminishing the competitiveness of their exports. Thirdly, financial market interdependence can also contribute to the transmission of a financial crisis, as preliminary instabilities in one country can lead international investors to withdraw their loans elsewhere, thereby generating a "credit crunch" in other emerging market economies. Finally, a financial crisis in one country can worsen market participants' perception of the economic conditions and prospects in other countries with similar characteristics, as a consequence setting off a widespread fall in international investors' sentiment. This empirical study will concentrate its analysis on this latter transmission mechanism of financial contagion in emerging market crises.

[3] For instance, when Moody's downgraded Japan's long-term foreign currency rating on November 18, 1998, from Aaa to Aa1, all other triple-A rated Japanese issuers were also downgraded by one rating-notch. This credit rating boundary of the sovereign ceiling can generate a fundamental problem for companies located in countries that have political or financial instabilities, but which would otherwise have high corporate credit ratings.

III.1 Shifts in Investor Sentiment

Following GOLDSTEIN (1998) a financial crisis in one country can operate as a "wake-up call" to institutional investors for reassessing other countries' economic conditions, even if the macroeconomic fundamentals have not objectively changed.[4] CALVO AND REINHART (2000) reasons that emerging market economies which are financially vulnerable may then be subject to contagion effects from a shift in market sentiment or an increased risk aversion, causing institutional investors to moderate the credit risk of their portfolios and "flee to quality".

The most promising targets are currencies that seem likely to be defended by central bank interventions in the exchange market and/or increases in domestic interest rates, but which look most probable to eventually collapse and generate speculative gains. CALVO AND REINHART (2000) argue that the probability of a financial market crisis triggered by a sudden change in market participants' sentiment is expected to be greater, the larger the country's share of short-term liabilities is and the larger the maturity mismatch between financial assets and outstanding debt, because the country will then be more exposed to a withdrawal by only a modest share of international investors. Emerging market economies with a weak banking system are particularly in danger because financial market participants may value this as an important limitation on the central bank's ability and willingness to raise interest rates in defense of a speculative currency attack (see CALVO (1997)).

According to CHANG AND VELASCO (2000), one common feature of all financial crises in emerging market economies during the latter half of the 1990s was international illiquidity. For instance, the crisis-ridden Southeast Asian countries had high and sharply increasing ratios of short-term liabilities to liquid assets. These emerging market economies were therefore extremely vulnerable to what CALVO AND REINHART (2000) term the "sudden stop syndrome", denoting an enormous reversal of capital inflows, which ultimately happened in Southeast Asian financial markets in the second half of 1997. CHANG AND VELASCO (2000) emphasize that the financial panic in emerging market economies strengthened by itself, causing institutional investors to recall loans and other market participants to withdraw funds from commercial banks. This behavior exaggerated the illiquidity of domestic financial institutions and generated just another cycle of costly asset liquidation and asset price deflation.

[4] GOLDSTEIN (1998) argues that Thailand acted as a "wake-up call" for international investors to reassess the creditworthiness of other Asian borrowers. When the market participants recognized that the other Southeast Asian emerging market economies had financial market weaknesses similar to those in Thailand, the institutional investors shortened their positions in these countries and ultimately the Asian crisis spread.

RADELET AND SACHS (2000) reason that the Asian crisis of 1997-98 was caused by a sudden shift in market participants' sentiment. Emerging market economies that relied on short-term capital inflows were trapped in a liquidity crisis when institutional investors declined to roll their claims forward. In Thailand and South Korea, domestic commercial banks could not obtain sufficient US dollars to pay off short-term liabilities when lenders refused to roll forward the countries' outstanding obligations. Nevertheless, ITO (2000) emphasizes that the Southeast Asian commercial banks were not insolvent rather that it was the market participants' anxiety of a probable bank run. The INTERNATIONAL MONETARY FUND (2001c) points out that when the Hong Kong SAR dollar came under severe financial market pressure in late October 1997, despite its solid macroeconomic fundamentals, investor sentiment concerning Asian financial markets shifted abruptly, and Southeast Asian economies that had been receiving huge capital inflows suddenly found it impossible to obtain new international financing and even experienced large capital outflows.

III.2 Hypotheses

There are two alternative views about the informational value of the agencies' credit ratings. One view is that credit rating agencies only have access to publicly available information and that the agencies generally lag the financial markets in processing that information. Proponents of this viewpoint reason that the frequency with which credit rating agencies review corporate and sovereign issuers is too low even to generate appropriate summaries of relevant public information (see GROPP AND RICHARDS (2001)). According to this argumentation, credit rating changes should not affect market prices, if financial markets are efficient in semi-strong form.

An alternative view is that credit rating agencies are specialists at obtaining and processing information, and thereby generate information on issuers' default risk that was not previously in the financial markets. A negative credit rating announcement might induce institutional investors to rebalance their portfolios for risk management, liquidity and/or other reasons. Sovereign credit rating changes may also reveal new information about a country and thus may encourage financial market rallies or downturns. This rating effect is likely to be stronger in emerging markets, where problems of asymmetric information and transparency are more severe.

Proponents of the asymmetric information framework emphasize that in financial markets information acquisition and processing is subject to free-rider problems, which can

be aggravated in the wake of a (rating) shock event. CALVO AND MENDOZA (2000b), for example, argue that because of the high costs of generating information, most market participants prefer to follow a handful of supposedly informed investors and financial analysts. As a result, the financial market will be subject to rumors and will exhibit herding behavior, since less informed investors choose mistakenly but rationally to "follow the herd" if they are evaluated based on their relative performance vis-à-vis other portfolio managers. These growing informational asymmetries might lead in the aftermath of a (rating) shock event to a homogeneously negative perception of overall credit quality so that creditors ultimately will withdraw their funds.

IV Methodology and Data

For assessing the characteristics of the emerging market countries that have been affected during the financial crises in the latter half of the 1990s, an operational definition of speculative market pressure is required. In contrast to previous empirical studies, for example REISEN AND VON MALTZAN (1999) and KAMINSKY AND SCHMUKLER (2002), which try to analyze the influence of credit rating agencies on emerging market crises by looking solely at the effects of sovereign credit rating actions on government bond yield spreads, this index of speculative market pressure should not contain government bond yield spreads for several central reasons.

Firstly, many of the emerging market economies do not have well-developed domestic financial markets implying that the construction of a reliable and comparable data set on government bond yield spreads is a problematical task, given the low liquidity of the sovereign bonds. Secondly, there is the general issue that government bonds are typically less liquid than stocks, and that the reported prices are often indicative quotes rather than actual trades. It can be very difficult to get accurate up-to-date pricing of all but a few benchmark issues. Previous empirical studies make also the factual error that they consider for their whole investigation and estimation period only a single sovereign bond, despite the fact that the maturity structure of these government bonds changes over time. Finally, especially during financial crisis episodes many of these emerging market governments' bonds are not traded on a regular basis and therefore not accurately priced.

IV.1 Index of Speculative Market Pressure

As the financial crises in the latter half of the 1990s have shown, when an emerging market economy suffers a deep financial crisis all domestic financial markets are affected at the same time: the currency weakens, domestic interest rates increase and stock market indexes slide. Therefore, in following the approach by KRÄUSSL (2003b), an index of speculative market pressure is specified as a weighted average of daily nominal exchange rate changes, daily short-term interest rate changes and daily stock market changes. The resulting index of a country's *i* daily speculative market pressure at time *t* is given through

$$SMP_{it} \equiv a_1 e_{it} + a_2 r_{it} + a_3 s_{it} \tag{1}$$

where e_{it} denotes the first differences of the nominal exchange rate, that is the price of one US dollar in country *i*'s currency at time *t*, r_{it} denotes the first differences of the domestic short-term interest rate, s_{it} denotes the first differences of the domestic main stock market index, and a_1, a_2 and a_3 are the weights assigned to these three factors, respectively. To prevent any of these three factors dominating the index of speculative market pressure, the volatilities of the three components are equalized, by assigning the variance weighted weights w_e, w_r and w_s to them.[5]

A higher speculative market pressure index *SMP* indicates greater pressure on the financial markets in country *i* at day *t* since it will be mirrored in higher values of the three components. Insofar as sovereign credit ratings convey new information to market participants, the expected rating effect on the index of speculative market pressure is straightforward: in case of a downgrade the index should rise, while in the occurrence of a positive rating action the *SMP* should fall.

IV.2 Event Study Approach

In order to study the dynamic effects of sovereign credit rating actions in country *j* on financial markets in the other countries $i \neq j$, event studies commonly used in the finance literature are employed. Standard event study methodology requires linking sovereign credit rating events to abnormal movements in the index, which is given as the difference between model-generated and actual market movements. The model-generated movement $\overline{SMP_{it}}$

[5] See KRÄUSSL (2003b) for a detailed discussion of the motivation and specification of this daily index of speculative market pressure.

which depends on the actual movements of the speculative market pressure index SMP_{it}^{m} is given by

$$\overline{SMP_{it}} = \alpha_i + \beta_i SMP_{it}^{m} + \varepsilon_{it} \tag{2}$$

with $\mathrm{E}[\varepsilon_{it}] = 0$ and $\mathrm{Var}[\varepsilon_{it}] = \sigma_{\varepsilon_i}^2$. However, the coefficients for model-generated movements have to be calculated for periods free of sovereign credit rating events. But since the relevant time series of sovereign credit ratings are much too short to calculate the coefficients within an event-free period, CAMPBELL, LO AND MACKINLAY (1997) proposes that α_i have to be constrained to zero and β_i to one.

As a consequence, the abnormal movements of the speculative market pressure index SMP_{it}^{a} are given in analogy to market-adjusted yield spreads as the difference between the model-generated movements and the actual variations:

$$\Delta SMP_{it}^{a} = \overline{SMP_{it}} - SMP_{it}^{m}. \tag{3}$$

This implies that the event study is based on the observed "foreign exchange spreads" between the domestic nominal exchange rates and the US dollar. In the case of short-term interest rates, the yield spreads between the domestic and the benchmark US short-term interest rates are exercised, while in the case of stock market indexes the "stock spreads" between domestic stock market indexes and the US S&P500 stock market index are utilized.

To perform event studies, "clean events" are necessary, that means that sovereign credit rating actions do not overlap. This distinction is important when considering an event window, in order to be able to isolate the effect of each sovereign credit rating. In the following, the sovereign rating effects will be examined ten days before and ten days after the event. As Figure 1 illustrates, the event is defined as day-zero, the period between the days 0 to +1 is defined as the event window, the period from the days –10 to –1 as the pre-announcement window, and the period from the days +2 to +11 as the post-announcement window.

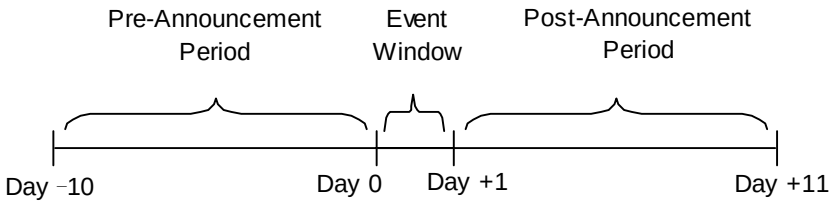

Figure 1: *The Event Window*

The event window is defined somewhat wider than just one day, because there is no exact information available on the announcement time of the sovereign credit rating action by the agencies and hence it is not possible to determine whether the announcement was done during trading or after trading on a given day. The index of speculative market pressure is set to 100 at day −10, once appropriate sovereign credit rating events are identified, in a way that it is more comfortable to measure the cumulative sovereign credit rating effects over time and at the same time, to compare different variations of the *SMP* across the emerging market economies.

IV.3 Panel Regression Analysis

By using panel regression analysis, the contemporaneous reaction of the speculative market pressure index in emerging market country *i* to changes in the sovereign credit rating of emerging market country *j* can be measured. In addition, the empirical analysis also investigates the potential impact of changes in the US short-term interest rate on financial markets in emerging market economies as suggested, for example, by EICHENGREEN AND MODY (1998) and CALVO AND MENDOZA (2000a). The fact that this empirical study uses daily data does not allow control for macroeconomic fundamentals, which are reported on a lower frequency. After controlling for past changes of the speculative market pressure index, the specification results suggest to integrating an AR(1) process in the model.

Following the modeling approach by KAMINSKY AND SCHMUKLER (2002), to examine whether there is a potential contagious rating effect of sovereign risk adjustments by the credit rating agencies, the resulting specification I is given by the pooled panel:

$$\Delta SMP_{it} = \alpha + \beta \Delta SMP_{it-1} + \gamma^{i} \Delta R_{it} + \gamma^{j} \Delta R_{jt} + \delta \Delta r_{t}^{US} + \varepsilon_{it} . \qquad (4)$$

The sub-indexes *i*, *j* and *t* stand for domestic country, foreign country and time, respectively. The error term ε_{it} is characterized by an independently distributed random

variable with mean zero and variance σ_{it}^2. Equation (4) is estimated using OLS, allowing for heteroscedastical residuals.

The variable ΔR_{it}^i stands for a sovereign credit rating action in country *i* at time *t* and is equal to 1 if there is a positive sovereign credit rating announcement by the agencies, equal to −1 when there is a negative sovereign credit rating announcement and equal to zero otherwise. If changes in sovereign credit ratings convey new information to market participants it is expected that $\hat{\gamma}^i < 0$, indicating that domestic sovereign credit rating downgrades lead to increases in the index of financial market pressure.[6]

The variable ΔR_{it}^j is similar to the latter but takes the value 1 when there is a positive sovereign credit rating announcement by either S&P or Moody's, the value −1 when there is a negative sovereign credit rating announcement, and is zero otherwise, in the foreign country *j* for $j \neq i$. If adjustments in foreign sovereign credit ratings transmit new facts to financial markets, it is expected that $\hat{\gamma}^j < 0$, which means that foreign sovereign credit rating downgrades in emerging market economies have a (negative) contagious rating effect on the domestic index of financial market pressure. Both changes in implemented sovereign credit ratings and imminent sovereign credit rating actions are examined in the same variable to avoid studying the potential rating effects of only a small number of credit rating agencies' announcements.

The variable Δr_t^{US} represents the change in US short-term interest rates, i.e., the interest rate given through 100 times $\log(1+r_t^{US})$. There are at least two probable transmission channels through which variations in US interest rates might have an effect on emerging markets' sovereign risk. Firstly, GERTLER AND ROGOFF (1990) emphasize that a rise in US interest rates increases the burden of the emerging markets' outstanding debt, thereby decreasing the countries' repayment capability. Secondly, EICHENGREEN AND MODY (1998) mention that increases in US interest rates can lessen institutional investors' "appetite for risk", thereby reducing the demand for risky high-yield assets from emerging market economies and, as a result, increasing the sovereign risk of these countries. For these reasons it is expected that $\hat{\delta} > 0$, since increases in US short-term interest rates may lead to a higher index of speculative market pressure.

[6] This expectation is in line with the empirical results by KRÄUSSL (2003b).

The financial crises in emerging market economies in the latter half of the 1990s and the speed at which financial turbulences in one country overwhelmed the country's region and even spread around the globe have produced an ever expanding literature on contagion in international financial markets. While opinions about the importance of different channels of transmission differ, many empirical studies conclude that financial contagion has been typically regional. KAMINSKY AND SCHMUKLER (2002) mention that it might be interesting to analyze whether these regional effects are also present when the potential contagious rating effects of sovereign credit ratings actions are examined. Therefore, the next specification II will be estimated through the pooled panel regression:

$$\Delta SMP_{it} = \alpha + \beta \Delta SMP_{it-1} + \gamma^{i} \Delta R_{it} + \gamma^{r} \Delta R_{rt} + \gamma^{nr} \Delta R_{nrt} + \delta \Delta r_{t}^{US} + \varepsilon_{it} . \qquad (5)$$

The variable ΔR_{it}^{r} takes the value 1 if there is a positive announcement on the sovereign credit rating, the value -1 if there is a negative sovereign credit rating action and the value zero otherwise, at time *t* by the credit rating agencies from country *r* for $r \neq i$. The index *r* represents an emerging market economy that belongs to the same geographic region as country *i*, given by either Asian, Latin American, Eastern European or African and Middle East economies. If changes in foreign but regional sovereign credit ratings convey new information to market participants, it is expected that $\hat{\gamma}^{r} < 0$, indicating that foreign sovereign credit rating downgrades of emerging market economies in the same region have a (negative) contagious rating effect on the domestic index of speculative market pressure in country *i*.

The variable ΔR_{it}^{nr} is similar to the latter but is equal to 1 for positive sovereign credit rating actions for emerging market economies outside the geographic region, equal to -1 for negative sovereign credit rating adjustments and equal to zero otherwise. It is expected that $\hat{\gamma}^{r} < \hat{\gamma}^{nr} < 0$, intending that a foreign sovereign credit rating downgrade outside the region have also a (negative) contagious rating effect on the domestic index of financial market pressure, but to a lesser extent than a credit rating announcement for a sovereign inside the region.

Another interesting issue is to examine the impact of substantial changes in international financial market conditions on emerging market economies. This topic has generated many academic articles following CALVO (1997), who emphasized the close connection of capital inflows to emerging market economies to US monetary policy during the early 1990s. Numerous empirical studies have focused on the relationship between net capital flows or foreign exchange reserves and interest rates in financial centers. Some

academics have paid attention to the linkages between returns in emerging market economies and returns in financial centers, while others concentrated on the effects of interest rate increases in financial centers on the interest rates and government bond yield spreads of emerging market economies.

As a consequence, specification III examines whether changes of the US short-term interest rate might have a stronger effect on vulnerable emerging market countries. For that reason, the sample is divided into two sub-samples according to the sovereign credit ratings assigned by S&P and Moody's. In particular, the observations are divided into two equal parts: sub-sample I consists of emerging market economies with investment-grade sovereign credit ratings and sub-sample II contains the governments with speculative-grade sovereign credit ratings. The resulting specification III is then given by the pooled panel

$$\begin{aligned} \Delta SMP_{it} = \alpha + \beta \Delta SMP_{it-1} + \gamma^{i} \Delta R_{it} + \gamma^{r} \Delta R_{rt} + \gamma^{nr} \Delta R_{nrt} \\ + \delta^{h} h_{it} \Delta r_{t}^{US} + \delta^{l} l_{it} \Delta r_{t}^{US} + \varepsilon_{it} \end{aligned} \tag{6}$$

with respect to: $h_{it} = \begin{cases} 1 & \text{IG} \\ 0 & \text{SG} \end{cases}$ and $l_{it} = 1 - h_{it}$.

Specification III is similar to equation (5), but it allows for examining explicitly the impact of a potential vulnerability effect by specifying two dummy variables h_{it} and l_{it}. Therefore, two different coefficients for the sensitivity to changes in US short-term interest rates will be estimated, notably δ^{h} for investment-grade sovereigns and δ^{l} for sovereigns that are rated below investment-grade by the credit rating agencies.

KAMINSKY AND SCHMUKLER (2002) indicate that it is expected for at least three reasons that emerging market countries with superior sovereign credit ratings should be less troubled by movements in US short-term interest rates due to the transmission channels of financial contagion. Firstly, given that superior sovereign credit ratings indicate a lower probability of the sovereign's default, changes in US short-term interest rates should have a greater impact on financial markets of countries with lower sovereign credit ratings. Secondly, governments with investment-grade sovereign credit ratings tend to have a lower level of external debt implying that the burden of outstanding (short-term) liabilities will become less intense in countries with higher sovereign credit ratings when US short-term interest rates increase. Finally, if there is a market participants' "flight to quality" when the US short-term interest rates increase, the financial markets of riskier emerging market economies, i.e., lower-rated by the credit rating agencies, should respond more sharply. Since it is expected that increases in US

short-term interest rates lead to a higher index of speculative market pressure, the coefficient of the riskier emerging market economies should be higher than the coefficient of the investment-grade sovereigns: $\hat{\delta}^l < \hat{\delta}^h < 0$.

IV.4 Data

The data set consists of daily sovereign credit ratings of long-term foreign currency debt which have been assigned by the two major credit rating agencies, S&P and Moody's. The observed period between January 1, 1997, and December 31, 2000 fully captures the financial market turmoil in the latter half of the 1990s, i.e., the financial market crises in Southeast Asia, Russia and Brazil. In the case of S&P, the sovereign credit rating history was obtained directly from its historical database on the Internet. However, in the case of Moody's, the press releases about its sovereign credit rating actions had to be collated and checked over the full four years to construct its sovereign credit rating history.

In total, a sample of 302 sovereign credit rating announcements assigned by the two agencies for the 28 countries in the sample during the period between January 1, 1997 and December 31, 2000 has been gathered. 69 of the credit rating agencies' announcements report actual sovereign credit rating downgrades and 43 actual upgrades, 42 sovereign credit ratings were assigned a negative rating outlook and 28 a positive rating outlook, 30 times sovereigns were put on negative credit watch and 14 times on positive credit watch, while the remainder contained sovereign credit rating confirmations or first assignments. A detailed illustration of the sovereign credit rating actions for all 28 emerging market countries employed in the empirical analysis during this period is presented in Table A1 in the Appendix.

Although the credit rating agencies use different symbols in assessing sovereign credit risk, every S&P's symbol has its counterpart in Moody's sovereign credit rating scale. This correspondence allows comparison of the sovereign credit ratings assigned by the two agencies. Moreover, it permits a linear transformation of the agencies' ordinal sovereign credit rating scales into numbers (see Table A2 in the Appendix). This linear transformation implies that a higher sovereign credit rating denotes a lower probability of (selective) default. As discussed above, the effect of a sovereign credit rating change is often partially incorporated into the institutional investor's credit risk judgments when the country is placed on review for a possible upgrade or a possible downgrade. In order to consider not only the implemented long-term foreign currency debt rating changes but also the credit rating

agencies' imminent rating actions, the numerical scale of the transformed sovereign credit ratings also contains positive and negative rating outlooks and credit watches.

The obtained sovereign credit rating history indicates that countries with a positive (negative) credit watch have never been downgraded (upgraded) at the next sovereign credit rating change. Moreover, about 60 percent of all credit watches in the sample have resulted in a sovereign credit rating change in the expected direction. As a result, the consideration of imminent sovereign credit rating actions is realized by adding 0.3 of one rating-notch for a positive credit watch by S&P and Moody's and by adding –0.3 of one rating-notch for a negative credit watch to the implemented sovereign credit rating. A positive rating outlook by S&P and Moody's is considered by adding 0.15 of one rating-notch, while a negative rating outlook by S&P and Moody's is taken into account by adding –0.15 to the implemented sovereign credit rating.

The other three types of data needed to build the speculative market pressure index are the daily nominal exchange rates, short-term interest rates and stock market price indexes. In the case of short-term interest rates overnight interbank interest rates are employed since the overnight interest (call) rate, i.e., the interest rate on the interbank market, is the typically watched indicator of liquidity conditions in the money market (see, for example, BORENSZTEIN AND LEE (2002)). In the case of stock markets the major national stock indexes are used, which are measured for each country in US dollars to enable comparison of stock market returns across countries in the same unit of account. All these three types of data were obtained from Bloomberg L.P., with holidays and weekends excluded. In case of missing values, the data were obtained from Datastream and from the websites of the emerging market economies' respective central banks.

Table 1 illustrates that the sample used in this study consists of 28 emerging and transition economy countries, while the inclusion criterion is that the sovereigns have to be rated both by S&P and Moody's throughout the period between January 1, 1997 and December 31, 2000. However, in the cases of Ecuador, Peru and Egypt, a country is employed in the empirical analysis when the sovereign is first rated by either S&P or Moody's. When the other credit rating agency also starts assessing this country, the averages of the adjustments of the sovereign credit ratings by both agencies are employed. in the Appendix indicates that when the credit rating agencies disagreed in their overall risk level assigned to an emerging market country, their sovereign credit ratings in most cases differed by only one rating-notch.

Table 1 *Emerging Market Countries Employed in the Empirical Study*

IMF	Country	S&P	Moody's	Stock Market Index
186	Turkey	X	X	ISE Nat 100
199	South Africa	X	X	JSE All Share
213	Argentina	X	X	General
223	Brazil	X	X	Bovespa
228	Chile	X	X	IPSA
233	Colombia	X	X	IBB General
248	Ecuador	07/29/00	07/24/97	ECGUB
273	Mexico	X	X	IPC
293	Peru	12/18/97	X	Lima General
299	Venezuela	X	X	IBC
469	Egypt	01/15/97	X	CMA
532	Hong Kong SAR	X	X	Hang Seng
534	India	X	X	BSE Sensex 30
536	Indonesia	X	X	Jakarta Composite
542	South Korea	X	X	Seoul Composite
548	Malaysia	X	X	KLSE Composite
564	Pakistan	X	X	Karachi 100
566	The Philippines	X	X	PSE Composite
576	Singapore	X	X	Straits Times
578	Thailand	X	X	Bangkok SET
686	Morocco	03/02/98	03/02/98	CASA CSG 25
922	Russia	X	X	Moscow Times
924	China	X	X	Shanghai A
935	Czech Rep.	X	X	PX 50
936	Slovak Rep.	X	X	SAX
944	Hungary	X	X	Bux
964	Poland	X	X	Wig
9998	Taiwan	X	X	Taiwan Weighted

Table 1 shows that the sample contains 11 Asian economies (China, Hong Kong SAR, India, Indonesia, South Korea, Malaysia, Pakistan, the Philippines, Singapore, Taiwan and Thailand), eight Latin American economies (Argentina, Brazil, Chile, Colombia, Ecuador,

Mexico, Peru and Venezuela), five Eastern European (Transition) economies (the Czech Republic, Hungary, Poland, Russia and the Slovak Republic), three African/Middle East economies (Egypt, Morocco and South Africa) and Turkey. Therefore, the empirical study analyzes exactly those countries which are classified by *The Economist* and the *Financial Times* as emerging market economies as of January 1997, with the exception of Israel.

Table 2 provides some useful measures of financial market stability in the sample.

Table 2: *Sample Statistics*

Log Change in Variable	**Mean**	**Median**	**Min**	**Max**	**SD**
Nominal Exchange Rate	0.0184	0.0155	0.0000	0.4241	0.0213
Stock Market Index	0.0142	0.0098	0.0000	0.3865	0.0167
Overnight Interest Rate	0.0219	0.0164	0.0000	0.4773	0.0258
SMP Index	0.0177	0.0143	0.0000	0.0435	0.0201

It shows that daily variations in absolute values are large in all three separate financial markets and oscillate around 1.8 percent for nominal exchange rates, around 1.4 percent for stock market indexes and around 2.2 percent for overnight interest rates, thereby resulting in a daily average movement in absolute value of about 1.8 percent for the index of speculative market pressure.

V Empirical Results

V.1 Short-Term Contagious Impact of Sovereign Credit Rating Actions

Table 3 presents the results of the event study of sovereign credit rating actions in country *j* on the financial markets of the countries *i* with $i \neq j$, for the ten trading days before and after the sovereign credit rating announcement as well as for the two-day event window, i.e., day-zero and day +1, for the date of the adjustment by the credit rating agencies. Table 3 reports the change of the cumulative mean of the speculative market pressure index separately for positive and negative sovereign credit rating announcements by S&P and Moody's, with the respective *t*-statistics and significance levels.

Table 3: *Short-Term Contagious Impact of Sovereign Credit Rating Actions*

Period	Positive	Negative
−10 to −1	−0.006 (−0.938)	0.011* (1.684)
0 to +1	−0.009* (−1.834)	0.016** (2.291)
+2 to +11	−0.009 (−0.815)	0.025*** (3.487)

The empirical results of the event study in Table 3 demonstrates a significant response to sovereign credit rating events with the expected sign in both sub-panels: a sovereign credit rating change in country *j* has a contagious impact on the financial markets in country *i*, while a positive (negative) sovereign credit rating announcement is associated with a sliding (rising) index of speculative market pressure.

While the event study results are statistically highly significant for negative sovereign credit rating announcements, they are in the case of positive sovereign credit rating actions only significant throughout the event window and then only at the ten percent level. Nonetheless, these empirical results suggest the existence of important spillover effects of changes in foreign sovereign credit ratings on the domestic index of speculative market pressure.

Figure 2 illustrates these event study results by presenting the cumulative abnormal movements of the speculative market pressure index in emerging market economy *i* around the time of positive and negative sovereign credit rating announcements in the countries *j*, which are the other 27 emerging market economies in the sample. The index of speculative market pressure is normalized to 100 at day −10, day-zero is the day of the sovereign credit rating action, and the gray color illustrates the event window constituted by day-zero and day +1.

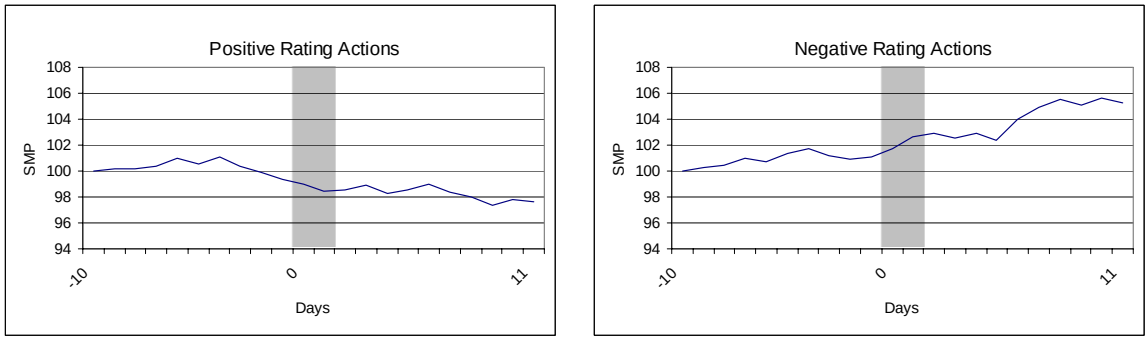

Figure 2: *Short-Term Contagious Impact of Sovereign Rating Actions*

Overall, Table 3 and Figure 2 indicate that the combination of the contagious rating effects during the event window and during the post-announcement period results in a considerable contagious rating impact of over 4 percent of a negative sovereign credit rating announcement in country *i* on the index of speculative market pressure of country *j*.

V.2 Country Studies: Short-Term Contagious Impact of Sovereign Rating Actions

In the following the event study approach is further applied for the empirical analysis of several sharp sovereign credit rating actions in different ground-zero countries and their potential contagious impact on other emerging market economies. The event windows are chosen in a way to consider the most prominent sovereign credit rating actions on the respective government while trying to analyze "clean events" to be able to isolate the rating effects of each sovereign credit rating announcement. The other emerging market economies i are chosen as those emphasized in the empirical literature on financial contagion as being mostly affected by spillover effects in the respective ground-zero countries during the financial market turbulences.

Figure 3 shows the financial market reactions in Indonesia, South Korea, Malaysia and the Philippines, around Thailand's sovereign credit rating downgrade by Moody's from Baa1 with a negative rating outlook to notwithstanding investment-grade Baa3 but still with a negative rating outlook on November 27, 1997, indicating that Thailand's government debt was only one rating-notch away from becoming a junk bond.

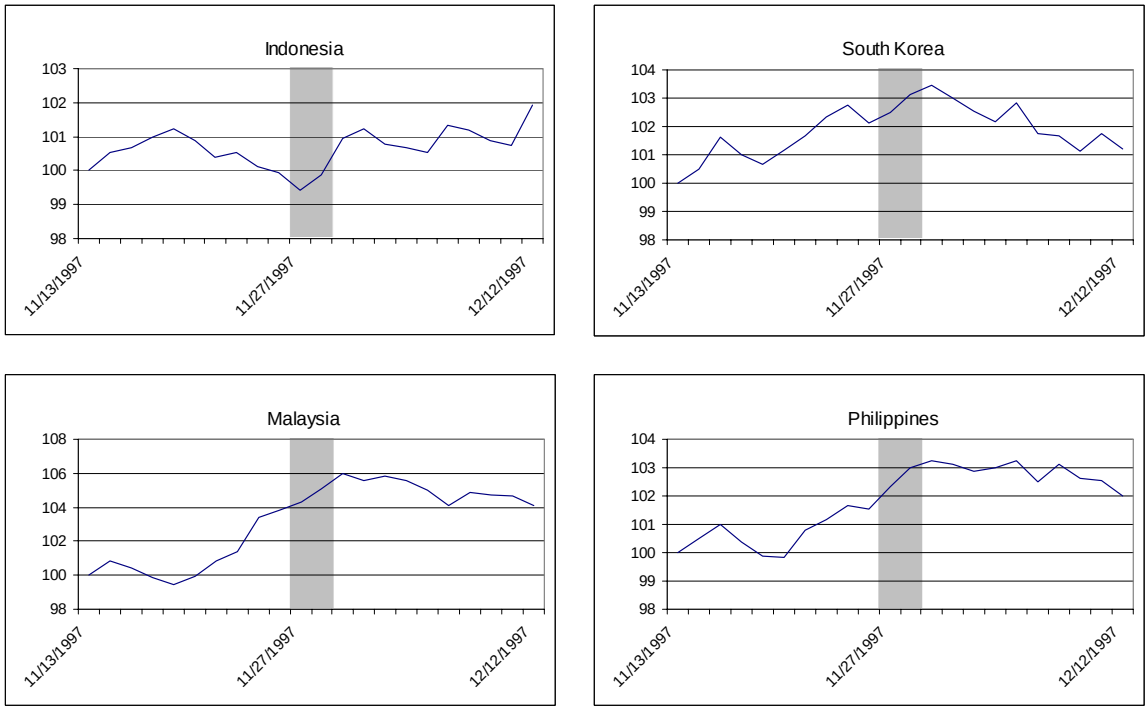

Figure 3: *Country Study: Short-Term Contagious Impact of Thailand's Credit Rating Downgrade on November 27, 1997*

The empirical results in Figure 3 suggest that Moody's lowering of Thailand's credit rating had a moderate short-term impact on the financial markets in the other Southeast Asian crisis economies. As expected from theoretical considerations, when the negative sovereign credit rating action in the ground-zero country should have a contagious rating effect on the other emerging market economies, the index of speculative market pressure rose in all four countries after Moody's sovereign credit rating downgrade of Thailand. The strongest contagious impact appears to be on the Malaysian financial markets, while the rating effect on the other Southeast Asian emerging market economies seems to be weaker. Moreover, as shown in Table 2, the daily average change in the speculative market pressure index oscillates around 1.8 percent, indicating that the negative sovereign credit rating announcement on Thailand did not have a strong contagious rating effect on the other Asian crisis-ridden emerging market countries.

However, during November 1997 there were many other pessimistic news reports in the financial markets which certainly contaminated the negative sovereign credit rating announcement of Thailand's long-term foreign currency debt and potentially had a strong effect on the other Southeast Asian emerging market economies' creditworthiness. For instance, on November 17, 1997 the South Korean central bank abandoned the defense of its currency. In addition, as Table A1 in the Appendix documents, South Korea's credit rating on

long-term foreign currency debt was repeatedly downgraded by the credit rating agencies in late November 1997.

In the days immediately following the negative sovereign credit rating action on the Thai long-term foreign currency debt rating, there was no contagious rating effect on the Argentine, Brazilian and Mexican financial markets. In fact, in the days succeeding the sovereign credit rating lowering of Thailand, the index of speculative market pressure slid in all three Latin American countries. Although, this is, admittedly, a somewhat simplistic analysis, the event study results might suggest that during November 1997 the financial market turbulences in Southeast Asia were not transmitted via sovereign credit rating changes to the financial markets in Latin America.

The graphs in Figure 4 illustrate the movements of the respective speculative market pressure index of the Philippines, Hong Kong SAR, Russia, Brazil, Argentina and South Africa ten days before and after the "sovereign rating crisis" on December 22, 1997.[7] Table A1 in the Appendix indicates that on that single day, Moody's downgraded Indonesia from investment-grade Baa3 with a negative rating outlook to speculative-grade Ba1, South Korea from investment-grade Baa2 with a negative credit watch by two rating-notches to non-investment-grade Ba1, Malaysia from investment-grade A1 to still investment-grade A2 and Thailand from investment-grade Baa3 with a negative rating outlook to speculative-grade Ba1, while S&P lowered South Korea's credit rating by four rating-notches from investment-grade BBB– with a negative credit watch to non-investment-grade B+ while still keeping a negative credit watch.

[7] See KRÄUSSL (2003) for a detailed analysis of the so-called sovereign rating crisis.

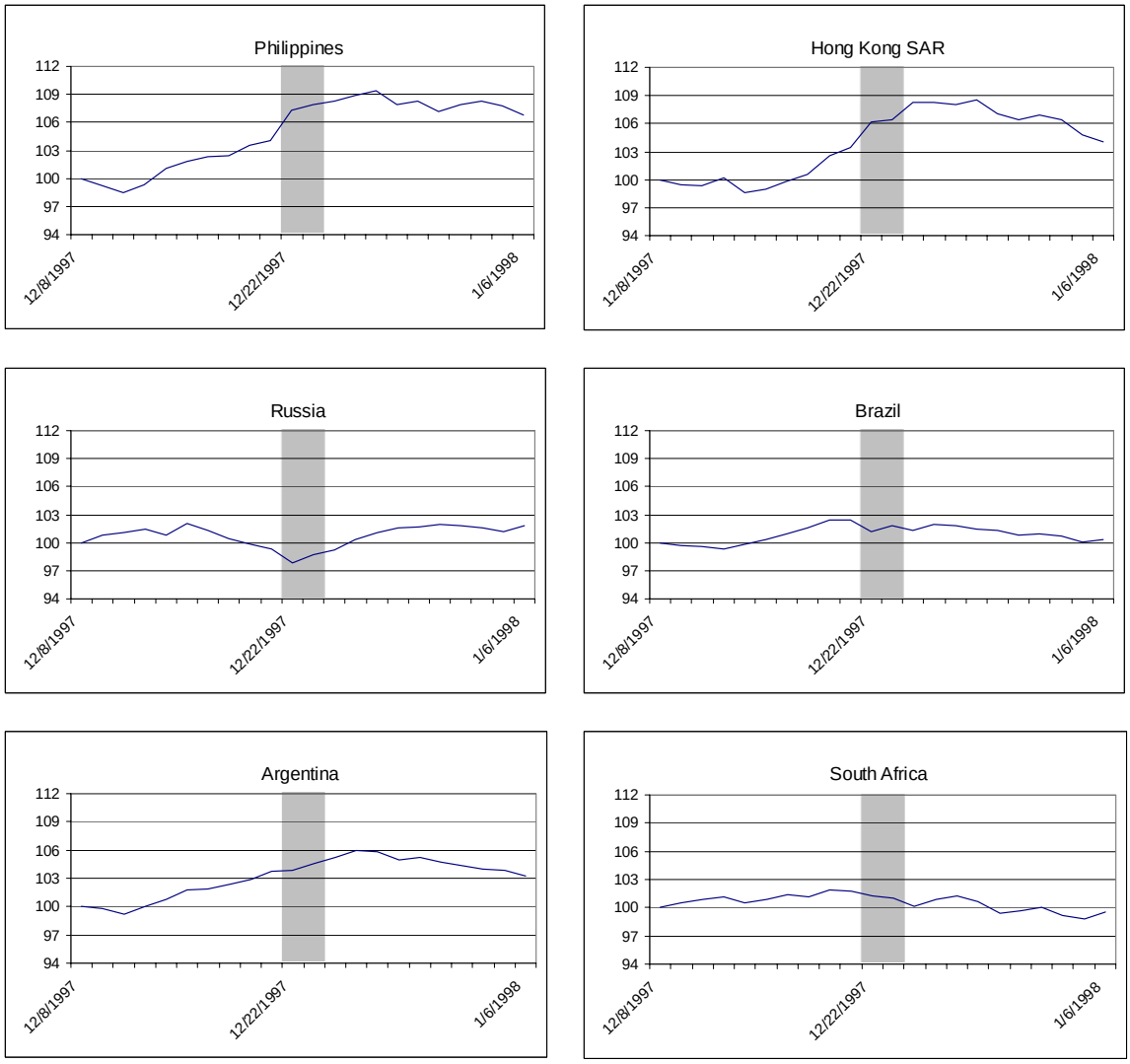

Figure 4: *Country Study: Short-Term Contagious Impact of the "Sovereign Rating Crisis" on December 22, 1997*

Figure 4 illustrates that these collective sovereign credit rating actions by S&P and Moody's resulted in sharp increases in the speculative market pressure index in the other Southeast Asian crisis economies, but to a much lesser extent on the financial markets of Russia, Brazil, Argentina and South Africa. These event study results indicate that the first-time assignments of sovereign credit ratings below investment-grade to Indonesia, South Korea and Thailand resulted in a sharp cutback in the willingness of market participants to take positions in Asian emerging market countries, but that these contagious rating effects were of a regional nature.

Figure 5 demonstrates the contagious rating effect of S&P's downgrade of Russian long-term foreign currency debt from B– with a negative rating outlook by two rating-notches

to triple-C while still keeping a negative rating outlook on August 17, 1998 on the financial markets of Brazil, Argentina, Mexico and Turkey.

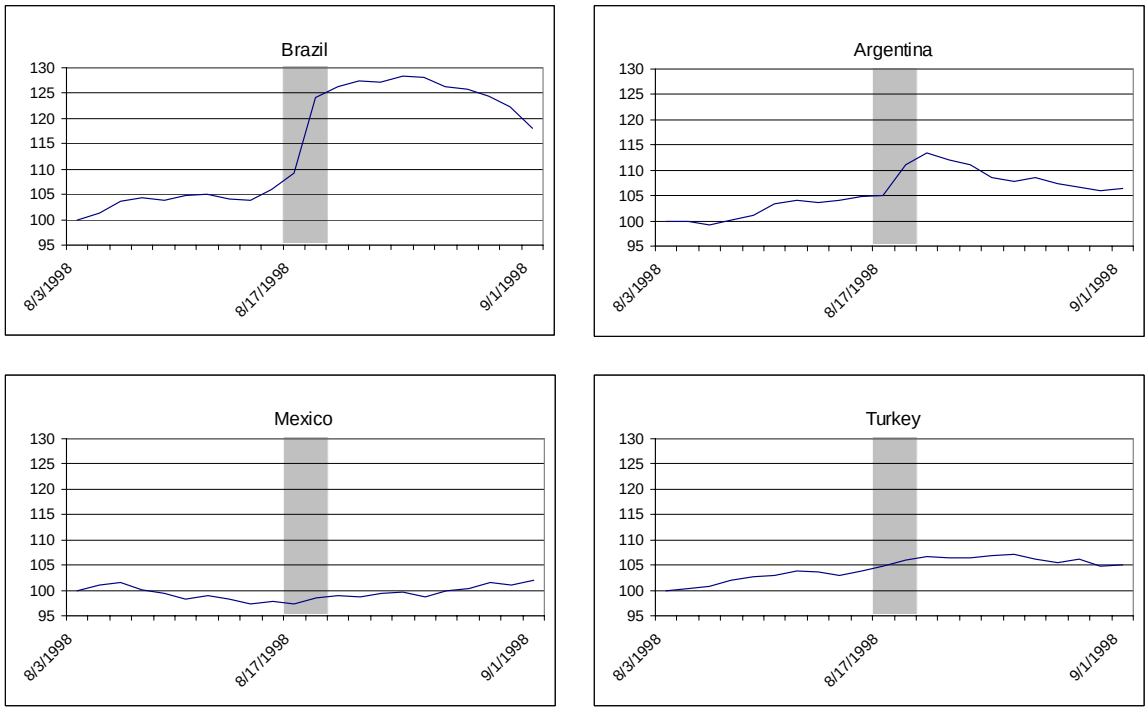

Figure 5: *Country Study: Short-Term Contagious Impact of Russia's Credit Rating Downgrade on August 17, 1998*

The movements of the respective speculative market pressure indexes show that the lowering of Russia's credit rating might have had a strong contagious impact on the other financial markets, particularly in the case of Brazil, where the *SMP* index jumped by more than 20 percent after the Russian credit rating downgrade by S&P. In the case of Argentina, immediately after August 17, 1998 the index of speculative market pressure rose by more than eight percent due to the huge rise in overnight interest rates and a sharp sliding stock market, but as Figure 5 shows, in the case of Argentina and strongly opposed to the financial markets reaction in Brazil, the contagious rating effects of Russia's credit rating downgrade were only short-lived.

The combination of the collapse of the Russian ruble and the debt moratorium of private principal payments announced by Russia on August 17, 1998 came as an immense shock to international investors, because the sovereign was viewed by many financial market observers as "too big too fail" or according to EDWARDS (2000) even as "too nuclear to fail". Therefore, the rising indexes of speculative market pressure in the aftermath of August 17, 1998, as illustrated in Figure 5, should not be entirely attributed to S&P's sovereign credit

rating change, because other negative financial market news unquestionably contaminated the contagious rating effects.

The graphs in Figure 6 portray the impact of Brazil's credit rating downgrade by one rating-notch from BB– with a negative rating outlook to B+ with still a negative rating outlook by S&P on January 14, 1999 on the financial markets of Argentina, Russia, Mexico and South Africa.

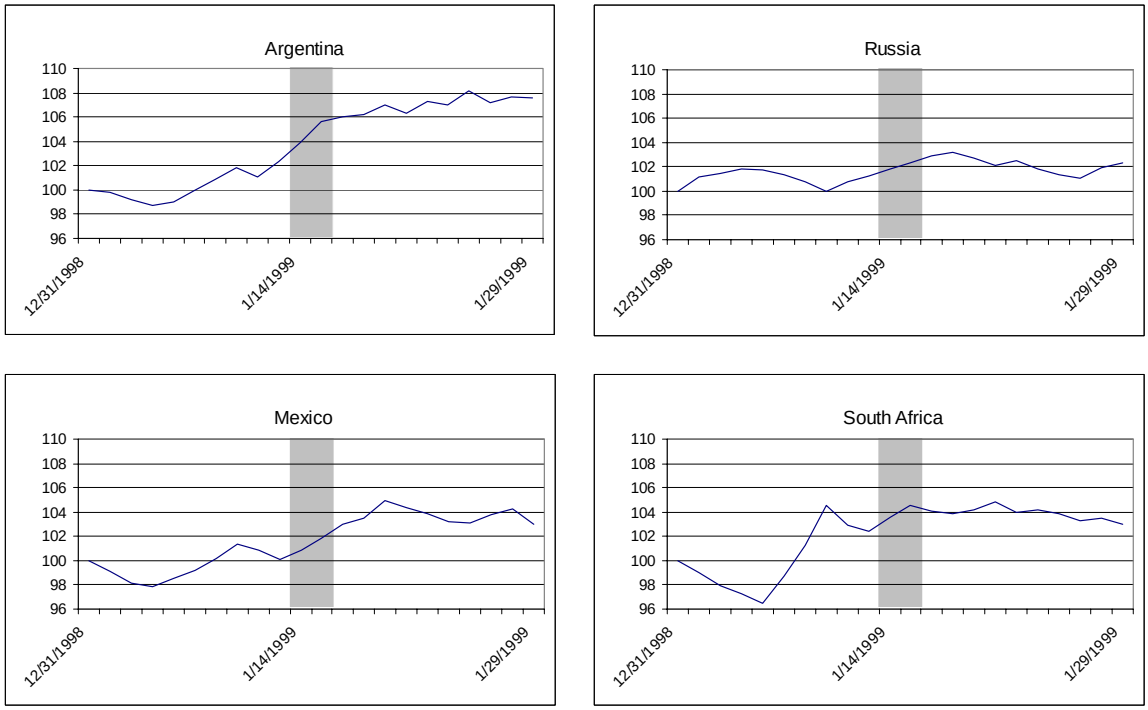

Figure 6: *Country Study: Short-Term Contagious Impact of Brazil's Credit Rating Downgrade on January 14, 1999*

Figure 6 shows that the movements in the speculative market pressure index following the downgrade of Brazil's long-term foreign currency debt seem not to have a significant contagious impact on the financial markets of Russia, Mexico and South Africa. Not surprisingly, the only exception is Argentina, where the index of speculative market pressure rose in the aftermath of the sovereign credit rating event by around five percent, since Brazil is Argentina's main trade partner.

However, this strong impact on the financial markets in Argentina should not be attributed only to S&P's credit rating action on Brazil in mid-January 1999, because simultaneously on January 13, 1999 the free-float of the Brazilian currency was announced by the central bank authorities. Moreover, during the following two weeks the Brazilian real lost

more than 30 percent of its value against the US dollar, leading to general fears of a devaluation of the Argentine peso.

V.3 Contemporaneous Contagious Effects of Sovereign Credit Rating Actions

The pooled panel equations (4) to (6) are estimated via OLS with robust standard errors, using the White correction for heteroscedasticity. Table 4 presents the panel regression results for specification I, i.e., the contemporaneous impact of sovereign credit rating actions in the ground-zero country *j* on the speculative market pressure indexes of the other 27 emerging market economies employed in this empirical analysis, with the respective *t*-statistics and significance levels.

Table 4: *Panel Regression Results Specification I*

Variable	**Specification I**
Constant	0.000 (–0.667)
Lagged *SMP*	0.105*** (5.122)
Domestic Rating	–0.017*** (–2.442)
Foreign Rating	–0.007** (–2.087)
US Interest Rate	0.035*** (2.949)
R^2	0.013

The pooled panel regression results in Table 4 show that the coefficient for the lagged dependent variable is, as expected, positive and statistically highly significant.[8] The coefficient for changes in domestic sovereign credit ratings is, also as hypothesized from theoretical reflections, negative and statistically highly significant at the one percent level,

[8] PESARAN AND SMITH (1995) mention that the size of the coefficient of the lagged dependent variable in a dynamic fixed-effect model might be biased. Nonetheless, the focus lies here on the significance and size of the exogenous variables, i.e., the size of the long-run effects is not of primary interest. Moreover, if the fixed-effect homogeneity restrictions were dropped, the consequence would be a considerable loss of degrees of freedom.

although at 1.7 percent it is less than the average daily change in the speculative market pressure index of 1.8 percent (see Table 1).

The coefficient for the foreign sovereign credit rating of the ground-zero country is as expected from theoretical considerations also negative and statistically significant at the five percent level. However, the empirical results suggest that the overall contemporaneous contagious impact of a sovereign credit rating action in country *j* is less than one percent on the financial markets of the other emerging market economies. These results indicate that changes in sovereign risk assessments have substantially stronger rating effects on the country being assessed by the credit rating agencies than on other countries. The coefficient of the US short-term interest rate has the right sign in specification I and is statistically highly significant at the one percent level.

The next specification II examines the hypothesis that the potential contagious impact of sovereign credit ratings is stronger within the same geographical region than across different areas. Therefore, four separate geographical regions, specifically Asia, Latin America, Eastern Europe and Africa/Middle East[9] are distinguished, and the pooled panel equation (5) is estimated via OLS. Table 5 presents the regression results with the respective *t*-statistics and significance levels.

Table 5: *Panel Regression Results Specification II*

Variable	**Specification II**
Constant	0.000 (−1.036)
Lagged SMP	0.105*** (5.210)
Domestic Rating	−0.018*** (−2.467)
FR Rating	−0.012** (−2.115)
FNR Rating	−0.005* (−1.739)
US Interest Rate	0.034*** (2.880)
R^2	0.013

[9] Turkey is included for the pooled panel estimation of specification IV in the African and Middle East sub-sample.

Table 5 displays that the estimated coefficients for the lagged dependent variable, the domestic sovereign credit rating and for the US short-term interest rate have the expected signs and are statistically highly significant at the one percent level.

The pooled panel regression results in Table 5 provide also evidence on a widely discussed issue in the contagion literature: whether financial contagion is regional or global. As expected from theoretical considerations and other empirical studies on financial contagion (see, for example, KAMINSKY AND SCHMUKLER (2002)), the empirical results indicate that the regional contagious impact (FR Rating) from sovereign credit rating actions seem to be stronger on the financial markets in emerging market economies than the contagious rating impact from other regions (FNR Rating).

Table 5 points out that the sovereign credit rating announcements within the region of country *i* lead to average increases of the speculative market pressure index of 1.2 percent while the contagious impact of sovereign credit rating changes from emerging market economies outside the region of country *i* result only in about half the contagious rating effect. Both coefficients are statistically significant but as can be seen from Table 1, the contagious rating effects of the sovereign credit rating changes in country *j* on country *i* are at 1.2 percent and 0.5 percent, respectively, even less than the daily average changes in the index of speculative market pressure of 1.8 percent.

Finally, specification III investigates whether interest rate changes in financial centers have a stronger market impact on vulnerable emerging market economies. As a consequence, specification III examines whether changes of the US short-term interest rate might have a stronger effect on vulnerable emerging market countries. For that reason, the sample of 28 emerging markets is divided into two sub-samples according to the sovereign credit ratings assigned by S&P and Moody's. In particular, the observations are divided into two equal parts: sub-sample I consists of emerging market economies with investment-grade (IG) sovereign credit ratings and sub-sample II contains the governments with speculative-grade ratings.[10] Table 6 presents the OLS regression results for the pooled panel equation (6) with the respective *t*-statistics and significance levels.

[10] The first sub-sample which contains investment-grade sovereign credit ratings consists of 14 countries, namely, South Africa, Chile, Colombia, Egypt, Hong Kong SAR, South Korea, Malaysia, Singapore, Thailand, China, the Czech Republic, Hungary, Poland and Taiwan, while the second sub-sample consists of the remaining 14 speculative-grade sovereigns, namely, Turkey, Argentina, Brazil, Ecuador, Mexico, Peru, Venezuela, India, Indonesia, Pakistan, the Philippines, Morocco, Russia and the Slovak Republic.

Table 6: *Panel Regression Results Specification III*

Variable	Specification III
Constant	0.000 (–1.075)
Lagged *SMP*	0.105*** (5.215)
Domestic Rating	–0.018*** (–2.479)
FR Rating	–0.012** (–2.187)
FNR Rating	–0.005* (–1.815)
US Interest Rate (IG)	0.026 (1.244)
US Interest Rate (SG)	0.042*** (2.487)
R^2	0.015

As expected from theoretical considerations, the estimation results in Table 6 demonstrate that speculative-grade rated sovereigns are more affected by changes in international interest rates, as measured by the US short-term interest rate, than by the agencies' investment-grade rated emerging market economies. The empirical results indicate that fluctuations in US short-term interest rates have with 4.2 percent versus 2.6 percent more than a 50 percent greater market impact on more vulnerable emerging market economies (those with speculative-grade sovereign credit ratings) than on less vulnerable emerging market economies (those with investment-grade sovereign credit ratings). Interestingly, emerging market economies with investment-grade credit risk assessments are not affected in a statistically significant way by changes in US short-term interest rates, while the coefficient for emerging market economies with non-investment-grade sovereign credit ratings is statistically highly significant at the one percent level.

It is central to keep in mind that all of the above specified and via OLS estimated pooled panel regressions implicitly assume that there is a zero correlation between the error term and the explanatory variables (see equations (4) to (6). However, such a correlation can come to pass if an explanatory variable is endogenously determined. That does not mean that the credit rating agencies' sovereign risk adjustments or changes in the US short-term interest rate would respond (immediately) to contemporaneous daily movements in the speculative

market pressure index, i.e., to movements in the nominal exchange rate, the overnight interest rate and/or stock market prices of the emerging market economies.

Nevertheless, a correlation between the one period lagged dependent variable ΔSMP_{it-1} and the error term ε_{it} is possible. For instance, Anderson and Hsiao (1982) mention that such a correlation can indeed arise when the true underlying model was in levels and then first differenced. In that case, the error term in the specified pooled panel regressions would be in first differences and correlated by construction with the lagged endogenous variable. To correct for potential biased coefficients, equation (6), i.e., specification III is estimated via two-stage least squares by employing as instruments the fourth lag of the dependent variable ΔSMP_{it-1}. Table 7 presents the 2SLS estimation results with the respective t-statistics and significance levels.

Table 7: *2SLS Panel Regression Results Specification III*

Variable	**Specification III**
Constant	0.000 (–1.092)
Lagged *SMP*	–0.521 (–1.156)
Domestic Rating	–0.021*** (–3.132)
FR Rating	–0.016*** (–2.570)
FNR Rating	–0.008* (–1.765)
US Interest Rate (IG)	0.025* (1.713)
US Interest Rate (SG)	0.041*** (2.445)
R^2	0.014

The statistics of Table 7 indicate that the empirical results of the specified pooled panel regressions are robust when controlling for potentially biased coefficients by using 2SLS estimation.

Overall, as all the above pooled panel regression estimations indicate, sovereign credit rating changes in the ground-zero country have a contagious impact on the financial markets

of other emerging market economies, as measured by the significant coefficients of the index of speculative market pressure. Nevertheless, this contagious rating effect is smaller than the rating effect of the sovereign credit rating announcements in the domestic country. Matching the findings by GLICK AND ROSE (1999), KAMINSKY AND REINHART (2002) and KAMINSKY AND SCHMUKLER (2002), these contagious rating effects tend to be regional, which means that the impact of domestic sovereign credit rating changes tends to be limited to the neighboring countries. Furthermore, the empirical results seem to suggest that lower-rated sovereigns are more vulnerable to changes in international interest rates as measured by movements in US short-term interest rates.

To check for robustness of the event studies and panel regression results, a number of alternative specifications based on S&P's and Moody's sovereign credit ratings have been applied, but none substantially improved the fit. In particular, the sovereign risk assessments from only one credit rating agency at a time were included or the higher or the lower sovereign credit rating for each country has been selected. A kinked function with a structural break instead of the linear transformation has been also considered.[11] Another alternative transformation of the sovereign credit rating symbols by S&P and Moody's is the logistic transformation which contains the hypothesis that risk perceptions first deteriorate slowly as rating-notches decrease, then deteriorate faster when sovereign credit ratings fall from investment-grade to speculative-grade, and finally deteriorate slowly again as sovereign risk assessments reach the bottom of the agencies' sovereign credit rating classification. However, both transformations did not change the empirical results of the event studies and panel regressions significantly.

In addition, several assumptions on which the event study is built are tested. Econometric tests applying the autocorrelation function (ACF) and the partial autocorrelation function (PACF) prove that the time series are not autocorrelated. The augmented Dickey-Fuller (ADF) test rejected the hypothesis that the time series are integrated of the order one or higher. The Jarque-Bera (JB) test could not reject the hypothesis that the time series follow a normal distribution in the sample or in any of the sub-samples. Furthermore, in the sample and all the sub-samples more than 75 percent of the sovereign credit rating actions have the right sign: the speculative market pressure index increases with a negative sovereign credit

[11] This transformation allows fully capturing the impact when the sovereign passes from investment-grade to non-investment-grade by allowing for a numerical change of three rating-notches instead of only one (see Table A1 in the Appendix). Additionally, the imminent sovereign credit rating actions between investment-grade and speculative-grade are also considered with a more heavy weight by adding + (–) one rating-notch for a positive (negative) credit watch, and by adding + (–) half a rating-notch for a positive (negative) rating outlook to the implemented sovereign credit rating.

rating action but decreases with a positive sovereign credit rating announcement by the credit rating agencies.

VI Conclusion and Outlook

The recent worldwide financial market instability has been the major focus of attention in both academic studies and the media. With the financial market crashes in Argentina and Turkey in 2001-02, this interest in financial market crises is not going to diminish in the foreseeable future. Numerous observers have made the case that international capital market globalization and integration is at the center of financial market instability, with highly diversified institutional investors showing little attention to emerging markets' economic fundamentals and instead following the herd of market participants in the presence of asymmetric information in financial markets.

Sovereign credit rating adjustments may also convey substantial new information about an individual country's creditworthiness. Credit rating changes for long-term foreign currency debt may act as a wake-up call with upgrades and downgrades in one country affecting other financial markets within and across national borders. Such a potential (contagious) rating effect is likely to be stronger in emerging market economies, where institutional investors' problems of asymmetric information are more present. Therefore, this empirical study has analyzed the role of credit rating agencies in international financial markets. In particular, the specific impact of sovereign credit rating changes during the financial turmoil in emerging markets in the latter half of the 1990s has been examined. The data set is not only expanded to update previous studies but also to test new hypotheses about the implications of sovereign credit rating changes on financial markets in emerging economies. This study complements earlier research by explicitly examining cross-security and cross-country contagious rating effects of credit rating agencies' sovereign risk assessments.

The results of the empirical study show that sovereign credit rating changes in a ground-zero country have a significant impact on the financial markets of other emerging market economies. However, this contagious rating effect is smaller than that of the sovereign credit rating announcements in the domestic country. Further, the spillover effects tend to be regional, which means that contagious rating effects tend to be limited to neighboring countries. Another substantial result of the empirical analysis is that speculative-grade rated emerging market economies are more vulnerable to interest rate changes in financial centers.

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Appendix

Table A1: *S&P's and Moody's Emerging Market Sovereign Credit Rating History (January 1997 to December 2000)*

IMF	Country	Date	S&P	Moody's
186	Turkey	01/01/1997	B (N)	Ba3 (N)
		01/09/1997		Ba3 (CW–)
		03/13/1997		B1 (N)
		08/10/1998	B (O+)	
		01/21/1999	B (N)	
		11/30/1999		B1 (O+)
		12/10/1999	B (O+)	
		04/25/2000	B+ (O+)	
		07/24/2000		B1 (CW+)
		12/05/2000	B+ (N)	
		12/22/2000		B1 (N)
199	South Africa	01/01/1997	BB+ (O+)	Baa3 (N)
		03/06/1998	BB+ (N)	
		07/17/1998		Baa3 (CW–)
		10/02/1998		Baa3 (N)
		02/07/2000		Baa3 (O+)
		02/25/2000	BBB– (N)	
213	Argentina	01/01/1997	BB– (N)	B1 (N)
		04/02/1997	BB (N)	
		10/02/1997		Ba3 (N)
		09/03/1998		Ba3 (CW–)
		02/10/1999		Ba3 (O–)
		07/22/1999	BB (O–)	
		08/20/1999		Ba3 (CW–)
		10/06/1999		B1 (N)
		02/10/2000	BB (N)	
		10/31/2000	BB (CW–)	
		11/14/2000	BB– (N)	
		11/21/2000		B1 (O–)
223	Brazil	01/01/1997	B+ (O+)	B1 (N)
		04/02/1997	BB– (N)	
		06/08/1998		B1 (O–)
		09/03/1998		B2 (N)
		09/10/1998	BB– (O–)	
		01/14/1999	B+ (O–)	
		11/09/1999	B+ (N)	
		02/29/2000	B+ (O+)	
		08/17/2000		B2 (CW+)

223	Brazil	10/16/2000		B1 (CW+)
228	Chile	01/01/1997	A– (N)	Baa1 (N)
233	Colombia	01/01/1997	BBB– (O+)	Baa3 (N)
		10/07/1997	BBB– (N)	
		05/21/1998		Baa3 (O–)
		09/30/1998		Baa3 (CW–)
		12/18/1998		Baa3 (O–)
		06/09/1999		Baa3 (CW–)
		06/11/1999	BBB– (O–)	
		08/11/1999		Ba2 (N)
		09/21/1999	BB+ (N)	
		04/10/2000	BB+ (O–)	
		05/23/2000	BB (O–)	
248	Ecuador	01/01/1997	n. r.	n. r.
		07/24/1997		B1 (N)
		04/17/1998		B1 (O–)
		06/08/1998		B1 (CW–)
		09/14/1998		B3 (N)
		10/05/1999		Caa2 (N)
		07/29/2000	SD	
		08/28/2000	B– (N)	
273	Mexico	01/01/1997	BB (N)	Ba2 (N)
		09/02/1997	BB (O+)	
		09/03/1998		Ba2 (CW–)
		10/02/1998	BB (N)	
		02/10/1999		Ba2 (O–)
		06/09/1999		Ba2 (N)
		06/21/1999		Ba2 (CW+)
		08/10/1999		Ba1 (O+)
		09/02/1999	BB (O+)	
		02/02/2000		Ba1 (CW+)
		03/07/2000		Baa3 (N)
		03/10/2000	BB+ (O+)	
293	Peru	01/01/1997	n. r.	B2 (N)
		12/18/1997	BB (N)	
		01/13/1998		B2 (O+)
		02/13/1998		B2 (CW+)
		03/27/1998		Ba3 (N)
		05/19/2000	BB (CW–)	
		06/15/2000	BB (N)	
		10/31/2000	BB– (N)	
		12/12/2000		Ba3 (O–)
299	Venezuela	01/01/1997	B (O+)	Ba2 (N)
		06/05/1997	B+ (N)	
		02/12/1998		Ba2 (O–)
		05/08/1998		Ba2 (CW–)
		07/22/1998		B1 (N)

299	Venezuela	08/31/1998	B+ (O–)	
		09/03/1998		B2 (N)
		12/21/1999	B (N)	
469	Egypt	01/01/1997	n. r.	Ba2 (N)
		01/15/1997	BBB– (N)	
		08/12/1997		Ba2 (O+)
		10/01/1997		Ba2 (CW+)
		11/14/1997		Ba1 (N)
		07/03/2000	BBB– (O–)	
532	Hong Kong SAR	01/01/1997	A (O+)	A3 (N)
		05/14/1997	A+ (N)	
		02/18/1998		A3 (O–)
		06/22/1998	A+ (CW–)	
		08/31/1998	A (O–)	
		09/03/1998		A3 (CW–)
		05/24/1999		A3 (N)
		12/07/1999	A (N)	
534	India	01/01/1997	BB+ (O+)	Baa3 (N)
		10/06/1997	BB+ (N)	
		01/08/1998		Baa3 (CW–)
		05/22/1998	BB+ (O–)	
		06/19/1998		Ba2 (N)
		10/22/1998	BB (N)	
		10/06/1999		Ba2 (O+)
		03/20/2000	BB (O+)	
		10/10/2000	BB (N)	
536	Indonesia	01/01/1997	BBB (N)	Baa3 (N)
		10/10/1997	BBB– (N)	
		10/27/1997		Baa3 (O–)
		12/22/1997		Ba1 (N)
		12/31/1997	BB+ (O–)	
		01/09/1998	BB (CW–)	
		01/27/1998	B (CW–)	
		03/11/1998	B– (CW–)	
		03/20/1998		B3 (N)
		05/15/1998	CCC+ (CW–)	
		07/08/1998	CCC+ (O–)	
		03/30/1999	SD	
		03/31/1999	CCC+ (N)	
		09/13/1999	CCC+ (CW–)	
		12/15/1999		B3 (O+)
		04/17/2000	SD	
		10/02/2000	B– (N)	
542	South Korea	01/01/1997	AA– (N)	A1 (N)
		08/05/1997		A1 (O–)
		08/06/1997	AA– (O–)	
		10/24/1997	A+ (O–)	

542	South Korea	11/25/1997	A– (CW–)	
		11/27/1997		A3 (N)
		12/10/1997		Baa2 (CW–)
		12/11/1997	BBB– (CW–)	
		12/22/1997	B+ (CW–)	Ba1 (N)
		01/09/1998		Ba1 (CW–)
		02/18/1998	BB+ (N)	
		03/30/1998		Ba1 (N)
		12/18/1998		Ba1 (CW+)
		01/04/1999	BB+ (O+)	
		01/25/1999	BBB– (O+)	
		02/12/1999		Baa3 (O+)
		08/23/1999		Baa3 (CW+)
		11/11/1999	BBB (O+)	
		12/16/1999		Baa2 (N)
548	Malaysia	01/01/1997	A+ (O+)	A1 (N)
		08/18/1997	A+ (N)	
		09/25/1997	A+ (O–)	
		12/22/1997		A2 (N)
		12/23/1997	A (O–)	
		02/05/1998		A2 (O–)
		04/17/1998	A– (N)	
		06/04/1998		A2 (CW–)
		07/23/1998		Baa2 (N)
		07/24/1998	BBB+ (O–)	
		09/14/1998		Baa3 (CW–)
		09/15/1998	BBB– (O–)	
		12/01/1998		Baa3 (O–)
		03/31/1999	BBB– (N)	
		04/20/1999		Baa3 (N)
		06/10/1999		Baa3 (O+)
		11/11/1999	BBB (N)	
		07/12/2000		Baa3 (CW+)
		09/01/2000	BBB (O+)	
		10/17/2000		Baa2 (N)
564	Pakistan	01/01/1997	B+ (N)	B2 (N)
		01/14/1998	B+ (O–)	
		05/22/1998	B+ (CW–)	
		05/28/1998		B3 (N)
		06/01/1998	B– (CW–)	
		07/14/1998	CCC (CW–)	
		10/12/1998	CCC– (O–)	
		10/23/1998		Caa1 (N)
		12/03/1998	CC (O–)	
		01/29/1999	SD	
		12/21/1999	B– (N)	
566	The Philippines	01/01/1997	BB– (O+)	Ba2 (N)
		01/23/1997		Ba2 (CW+)

566	The Philippines	02/21/1997	BB+ (O+)	
		05/19/1997		Ba1 (N)
		09/25/1997	BB+ (N)	
		02/23/1998	BB+ (O–)	
		01/06/1999	BB+ (N)	
		10/19/2000	BB+ (O–)	
		10/27/2000		Ba1 (O–)
576	Singapore	01/01/1997	AAA (N)	Aa1 (N)
578	Thailand	01/01/1997	A (N)	A2 (N)
		02/13/1997		A2 (CW–)
		04/08/1997		A3 (N)
		07/24/1997		A3 (O+)
		08/01/1997	A (CW–)	
		09/03/1997	A– (O–)	
		09/09/1997		A3 (CW–)
		10/01/1997		Baa1 (O–)
		10/24/1997	BBB (O–)	
		11/27/1997		Baa3 (O–)
		12/22/1997		Ba1 (N)
		01/08/1998	BBB– (O–)	
		05/03/1999		Ba1 (O+)
		05/05/1999	BBB– (N)	
		04/03/2000		Ba1 (CW+)
		06/22/2000		Baa3 (N)
686	Morocco	01/01/1997	n. r.	n. r.
		03/02/1998	BB (N)	Ba1 (N)
922	Russia	01/01/1997	BB– (N)	Ba2 (N)
		12/19/1997	BB– (O–)	
		02/03/1998		Ba2 (CW–)
		03/11/1998		Ba3 (N)
		05/27/1998	BB– (CW–)	
		05/29/1998		B1 (N)
		06/09/1998	B+ (N)	
		08/13/1998	B– (O–)	B2 (N)
		08/17/1998	CCC (O–)	
		08/21/1998		B3 (N)
		09/16/1998	CCC– (O–)	
		01/27/1999	SD	
		04/10/2000		B3 (O+)
		08/23/2000		B3 (CW+)
		11/13/2000		B2 (N)
		12/08/2000	B– (N)	
924	China	01/01/1997	BBB (O+)	A3 (N)
		05/14/1997	BBB+ (N)	
		02/19/1998		A3 (O–)
		07/16/1998	BBB+ (O–)	
		09/03/1998		A3 (CW–)

924	China	12/03/1998		A3 (N)
		07/21/1999	BBB (N)	
935	Czech Rep.	01/01/1997	A (N)	Baa1 (N)
		11/05/1998	A– (N)	
936	Slovak Rep.	01/01/1997	BBB– (N)	Baa3 (N)
		11/03/1997		Baa3 (O–)
		01/20/1998		Baa3 (CW–)
		03/30/1998		Ba1 (N)
		04/07/1998	BBB– (O–)	
		09/17/1998	BB+ (O–)	
		10/01/1998		Ba1 (CW–)
		02/18/1999		Ba1 (O–)
		10/27/1999		Ba1 (N)
		11/12/1999	BB+ (N)	
		11/07/2000		Ba1 (O+)
		11/09/2000	BB+ (O+)	
944	Hungary	01/01/1997	BBB– (N)	Baa3 (N)
		11/05/1997		Baa3 (O+)
		01/22/1998	BBB– (O+)	
		03/20/1998		Baa3 (CW+)
		05/08/1998		Baa2 (O+)
		12/11/1998	BBB (O+)	
		06/25/1999		Baa1 (N)
		02/02/2000	BBB+ (O+)	
		04/10/2000		Baa1 (O+)
		09/13/2000		Baa1 (CW+)
		11/14/2000		A3 (N)
		12/19/2000	A– (N)	
964	Poland	01/01/1997	BBB– (N)	Baa3 (N)
		06/03/1997	BBB– (O+)	
		12/03/1998		Baa3 (O+)
		06/10/1999	BBB (O+)	
		09/02/1999		Baa1 (N)
		05/15/2000	BBB+ (N)	
9998	Taiwan	01/01/1997	AA+ (N)	Aa3 (N)
		12/06/2000	AA+ (O–)	

Table A2: *Linear Transformation of Sovereign Credit Rating Scales*

S&P	Moody's	Linear Scale	Structural Break
AAA	Aaa	20	22
AA+	Aa1	19	21
AA	Aa2	18	20
AA–	Aa3	17	19
A+	A1	16	18
A	A2	15	17
A–	A3	14	16
BBB+	Baa1	13	15
BBB	Baa2	12	14
BBB–	Baa3	11	13
BB+	Ba1	10	10
BB	Ba2	9	9
BB–	Ba3	8	8
B+	B1	7	7
B	B2	6	6
B–	B3	5	5
CCC+	Caa1	4	4
CCC	Caa2	3	3
CCC–	Caa3	2	2
CC	Ca	1	1
SD	C	0	0

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