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Abstract

Credit default swap(CDS) is a new developed derivative to insure the credit risk of an underlying entity. This paper investigates the correlation relationship of the CDS market of sovereign borrowers and sovereign bond market. Applying the formula in the paper of Hull et al.(2004), an implied default-free rate(also called benchmark rate) of CDS market is computed; its correlations with US treasury and LIBOR are tested respectively. The tests indicate that, in sovereign CDS market, the benchmark is more related with US treasury, although LIBOR has been used as the best approximation of market benchmark in both academia and industry. Therefore, this paper suggest the importance of US treasury to sovereign CDS market in measuring market's reference and searching for mispriced chance.

In addition, a spuriously controversy result are found as rating-specific CDS benchmark rates are contrasted. A monotonic decrease of these benchmarks is clearly observed for the sovereigns with lower credit rating and higher default risk. The phenomenon is carefully explained and the main reason comes from the higher CDS rate than yield spread. This invites a further comparison of the price discovery processes in sovereign CDS market and the corresponding sovereign bond market.

1 Introduction

The purpose of developing credit default swap(CDS) is to extract credit risk from other risks, and trade on it more efficiently. The idea of CDS contract comes from life insurance. You pay predeterminate fixed annual fee to buy an insurance– a CDS contract, use it to redeem the loss of your lending money upon the default of the borrower. The annual fee is named CDS rate, representing the market expected default risk premium. Besides, yield spread calculated by bond yield over default-free rate, is another measure of default risk in bond market. As CDS market being more developed, the convergence of these two default risk measures and the efficiency of CDS market are widely questioned and examined by people from academia and industry.

This paper is a continuation of the topic with a concentration of CDS of sovereign bonds in emerging market. The arrangement of this paper is the following: section two is a review of previous research on the relation of CDS market and bond market; section three talks about the methodology; section four gives data description and analysis; section five shows regression results and findings; the last section is the conclusion.

2 Previous research on credit risk

Credit risk has been extensively discussed since late 1900. Previous research focus on the dynamic pricing mechanism of Credit risk premium. There are two types of models extensively used: structural models by Black and Scholes(1973) and Merton(1974); reduced form models by Litterman and Iben(1991), Jarrow and Turnbull(1995). Various macro or market-level factors are used in these models, and their explanation powers to the variation of credit risk have been widely proved. Meanwhile, debates of these models are raised due to the low goodness of fit– the large proportion of unexplained variation in credit risk. Elton et al.(2001) find taxation and systematic risk premia only account for two-thirds of the yield spread, and Collin-Dufresne et al.(2001) show that factors suggested by traditional credit models explain only one-forth of the variation in yield spread.[1] More research and new approaches, therefore, are needed to solve the puzzle. Moreover, the limited number of research on CDS can no longer satisfy the exploded need of credit derivative market.

literatures on the relationship of CDS and bond markets which is mostly interested by

[1] A detailed review on these debates is in Blanco(2004).

market practitioners, are much fewer. A group of research come out recently become building blocks in this field. Hull et al.(2004) study the arbitrage relationship of CDS rate and yield spread. Blanco et al.(2004) analysis dynamic relationship between investment-grade bonds and credit default swaps, conclude that CDS is the upper bound and yield spread is the lower bound of credit risk premium. Chan-Lau and Kim (2004) find no equilibrium price relationship between sovereign CDS and sovereign bond markets although prices converge in long term.

Due to the limitation of CDS data, these studies work on general CDS data with a mix of corporation borrowers and sovereign borrowers. Researchers and market participants both prefer LIBOR to US treasury as being the measure of implied benchmark risk-free rate in CDS market, saying that LIBOR is less volatile and more reasonable. However, in this study of the sovereign CDS before May 2002, I find US treasury is the better measure and treasury curve should be readopted by participants in sovereign CDS market. Both the econometric tests and the study of market behavior give a strong support to this conclusion.

3 Methodology

In this paper, both econometrics and analytical study are used on the features of sovereign CDS market. Hull et. al(2004)'s regression models are to compare the closeness of US treasury or LIBOR to CDS benchmark. Rating shocks are imposed lately to the regressions to reexamine their relationship. Analytical study on market behavior is followed to search the reasons behind.

3.1 A contemporary arbitrage relationship

CDS contract is usually bought by investors in the corresponding bond market, to earn an insured risk free return by transferring their default risk to CDS seller. This risk free return is the difference of bond yield over CDS rate.

Calculation Formula: $r = y - s$

Where, y is n-year par yield, s is n-year CDS rate, and r is the n-year risk free return named the implied benchmark rate in CDS market. If CDS and bond markets are well co-integrated,and CDS rate is correctly priced, this implied benchmark in CDS market should equal the benchmark rate in bond market. Since US treasury or LIBOR is commonly used benchmark,

Arbitrage relationship: $r = r_T$; $r = r_S$.

Where,r_T is US treasury yield, r_S is LIBOR rate. It is same as to say the equilibrium of CDS rate with yield spread. Where there is an equilibrium, there is no arbitrage, the relationship of CDS and bond markets will be stable.

3.2 Regression models in Hull et al.(2004)

In practice, the equilibrium is affected by the following reasons:

1. The cheap-to-deliver bond option in CDS contract;
2. The counterpart default risk in CDS market;
3. The Repo cost in bond yield;
4. Liquidity difference of CDS and bond markets;
5. Regulation (like taxation) difference in two markets.

Besides, as discussed by Hull et al.(2004), CDS gives the holder the right to sell the par bond for its face value plus accrued interest so CDS rate should be adjusted by this accrued interest due before default.[2] $\frac{y}{4}$ is used to measure the accrued interest. The calculation of implied benchmark therefore is also adjusted.[3]

Adjusted Formula:

$$r = y - s(1 + \frac{y}{4}) \tag{1}$$

The equilibrium relationships are tested by two similar regressions.

Regression Models:

$$r = a + b_1 r_T + \epsilon \tag{2}$$

$$r = a + b_2 r_S + \epsilon. \tag{3}$$

When applying Hull et al.'s models (equation (2) and (3)), I firstly examine the arbitrage relationship by the join hypothesis $H_0 : a = 0$ and $b = 1$; then, two separate hypotheses $H_0 : a = 0$ and $H_0 : b = 1$. In order to be compared with Hull et al's, student t tests are mostly used, after the join hypothesis is rejected.[4]

[2] See Hull et al.(2004) for detailed description.

[3] These linear regressions are valid since the explanatory variable r_T or r_S is not systematic correlated with ϵ: the disturbances in CDS market.

[4] F test on the join hypothesis is different from t tests on each part of the join hypothesis. T tests are necessary when the join hypothesis rejected. Since both Hull et al.'s research and my result reject the strict

3.3 The impact of rating events on the relationship

Rating events are updated public information about the change of credit risk, which will affect both bond and CDS markets. Previous research on the relationship of CDS and rating finds that negative outlook of a borrower will push up its CDS rate; formal rating change, on the contrast, will not bring big shocks to CDS market. Research on the relationship of bond and rating have similar findings.

When the equilibrium is loosely held, or the correlation between the benchmark rates is statistically stable, new coming information will have same impact on CDS and bond yield, therefore not affect their equilibrium. To test the stability of the regressive relationship, I added a measure of rating events– q into equation (2) and (3).

Rating events include rating changes and outlook changes. Value of q at time t is generated by

$$q_t = \frac{m_t}{n_t}.$$

Where, m_t is the total number of rating events until time t, n_t is the total number of the total observations until time t. q is not the cumulative frequency or probability of rating events, since n_t is changing over time. [5] Thus, two extended regression models are also estimated:

$$r = a + b_1 r_T + cq + \epsilon \tag{4}$$

$$r = a + b_2 r_S + cq + \epsilon. \tag{5}$$

4 Data analysis

In this paper, I use daily data of sovereign Euro-bond yield spreads, CDS rates, and US treasury yields from 04/01/1999 until 5/22/2002, provides by an anonymous broker. Among them, I choose 5 year as the constant time to maturity, since 5-yr CDS is the most liquid. 5-year daily LIBOR rates are from the online database of Federal Reserve. Information on rating events are extracted from S&P's Rating History. There are totally 46 Euro-bonds under 20 sovereign entities, mostly in emerging markets.

To get 5-year bond yields of each sovereign entity, I use linear interpolation of reference yields under the same sovereign name and get 2401 yield spreads under 8 sovereigns. 12

arbitrage relationship, t tests are applied

[5]The cumulative probability is calculated by the total number of observations which is constant over N.

sovereigns are dropped due to the lack of reference bonds, or unmatched time to maturity. [6]

According to S&P's rating history (see Table 15), during 04/01/1999 to 05/22/2002, there are 48 rating events of the 8 sovereigns, including rating changes and outlook changes. Their ratings at 05/22/2002 are:

	Investment Grades			Speculation Grades				
Sovereign	Korea	South Africa	Mexico	Egypt	Russia	Brazil	Venezuela	Argentina
Rating	A-	BBB	BBB-	BB+	BB	BB-	B	D

The euro-bonds are in US dollars with fixed semi-annual coupons. They are assumed having identical properties, so that their yield spreads only embed sovereign-level default premiums, no bond-specific default premiums needed to be considered.

5 Regression results

5.1 Overall arbitrage relationship

Hull et al.(2004)'s t tests show $a = 0$ is accepted but $b = 1$ is rejected, the arbitrage relationship is not strictly held. However, the values of r and r_S are found very close, in practice, r–the benchmark in CDS market can always be measured by inflating r_S–LIBOR rate with 10bps.[7]

Except defaulted Argentina, 7 sovereigns from rating A to B are pooled together and regressed. Both F and t tests reject the null hypotheses of having a arbitrage relationship on 95% confidence level. $a = 0$ can be accepted at 1% significant coefficient, but rejected at 5% significant coefficient; $b = 1$ is rejected with no doubt. r_T explains 31.95% of total variation in r at equation (2); r_S explains 28.57% of total variation in r at equation (3). To confirm the significance of the difference in these two regressions, I use $F_{1935,1935}$ distribution. It turns out that US treasury is a better regressor than LIBOR to the implied benchmark.

[6] The interpolation requires at least one bond with a time to maturity(T) less than 5 yrs, and one bond with a T longer than 5 yrs and shorter than 10 yrs.The selected sovereigns usually have 2 or 3 reference bonds, the linear spine interpolation approach is adopted.

[7] 10bps gets from their estimate of $r - r_S$ for Aaa and Aa borrowers. The estimates for other rating classes are not used for the measure to get rid of the counterpart default risk in a CDS. See Hull et al.(2004) for details.

Table 1: Pool Regressions on US Treasury Yield(r_T)

	Hull's Case	Sovereign Case		
		Pool	Investment Grade	Speculation Grade
a	0.12	-1.05359	0.33422	-2.79665
SE of a	0.07	0.18143	0.12573	0.21509
b_1	1.1	1.19831	1.01946	1.49835
SE of b_1	0.014	0.03973	0.02839	0.04628
SE of Residual	0.25	0.85261	0.27374	0.86382
Adjusted R^2	0.941	0.3195	0.6402	0.4637
No.	370	1937	725	1212

Table 2: Pool Regressions on LIBOR Rate(r_S)

	Hull's Case	Sovereign Case		
		Pool	Investment Grade	Speculation Grade
a	0.09	-0.37150	0.79152	-1.87362
SE of a	0.059	0.17207	0.13129	0.20628
b_2	0.972	0.90367	0.79075	1.11860
SE of b_2	0.01	0.03245	0.02559	0.03819
SE of Residual	0.203	0.87352	0.30086	0.90268
Adjusted R^2	0.961	0.2857	0.5686	0.4144
No.	370	1937	725	1212

5.2 Loose arbitrage relationship appeared at *Investment Grade Rating*

Since the ratings of the sample sovereigns vary widely, structural changes or inconsistency of parameters across rating grades are suspected. The data, therefore, are divided into two rating groups: 3 sovereigns in investment grade group and 4 sovereigns in speculation grade group. Regression results on each group are summarized in Table 1 and Table 2. Hull et al.'s results are listed in the same tables for comparison. The chow test shows significant structural difference over groups. The formula is

$$F = \frac{(RSS_1 - RSS_2 - RSS_U R)/K}{(RSS_1 + RSS_2)/(N - 2K)}.$$

The computed F values are

$$r_T : F_{chow} = 453.50; r_S : F_{chow} = 390.77.$$

The goodness of fit and the standard errors are greatly improved in group regressions. It also shows a hint on the pricing gap between investment and speculation rating grades.

Among these results, the regression on US treasury yield in investment grade group is most significant. It has better fit, where $a = 0$ is accepted at 0.5% significant level, and $b = 1$

Table 3: Regressions for Speculation Group

	US treasury yield r_T			LIBOR rate r_S		
	——	Rating changes	Outlook changes	——	Rating changes	Outlook changes
a	-2.79665	-2.18104	-2.08156	-1.87362	-1.32624	-1.16526
SE of a	0.21509	0.15145	0.22554	0.20628	0.15160	0.21857
b	1.49835	1.35707	1.38401	1.11860	1.01949	1.02210
SE of b	0.04628	0.03119	0.04698	0.03819	0.02693	0.03900
q	——	30.17247	-73.97128	——	21.60688	-75.53949
SE of q	——	3.34295	8.74955	——	3.62235	9.19735
SE of Residual	0.86382	0.52784	0.83971	0.90268	0.57701	0.87887
Adjusted R^2	0.4637	0.6706	0.4932	0.4144	0.6064	0.4449

is accepted at higher significant level. The arbitrage relationship exists. The relationships are not held for the regression on LIBOR in investment grade group and all regressions in speculation group. Compared with Hull et al.'s results, the estimate of intercept a is much greater in absolute value and the goodness of fit is lower. These may imply the existence of other latent fixed and/or random effect. Group regressions also show strongly proof that US treasury yield explains implied benchmark better than LIBOR.

5.3 Rating events affect the relationship at *Speculation Grade Rating*

Rating events time series q is introduced to the original equation, the extended regression models (4)and (5) are regressed. The impacts of rating change and outlook change are estimated separately to compare their different impacts on CDS.

There are 6 rating changes and 8 outlook changes in the pool regressions. Besides, Argentina has 7 rating changes and 4 outlook changes before its default. Although the estimates of the partial coefficient of q for each group are both significant, the regressions in speculation grade group are much improved, the impact of rating change is more significant than outlook change ; the regressions in investment grade group have no big change. Due to the limitation of rating events, I have not differentiated the changing directions of these events. The estimations for speculation grade group are summarized at Table 3. The regression on Argentina is presented at Table 12 in appendix.

Table 4: Mean of benchmarks

Benchmarks	The Mean Procedure		
	Pool	Investment Grade	Speculation Grade
r	4.3876	4.8342	4.12042
r_T	4.5407	4.4141	4.61646
r_S	5.2664	5.1125	5.35850

6 An analytical study

6.1 Why implied benchmark much closer to US treasury?

Hull et al.'s estimations find LIBOR and US treasury are efficient upper and lower boundaries of the implied benchmark and the value of r more closes to LIBOR. To sovereign CDS in emerging market, these boundaries, however, are only meaningful at investment grade. For the borrowers at speculation grade, the implied benchmark drops below US treasury yield. US treasury is more efficient than LIBOR to be the upper bound. These differences are illustrated at following inequalities and Table 4.

Hull et al.(2004)'s Case:

$$r_T \leq r \leq r_S; \frac{r - r_T}{r_S - r_T} = 0.904 \tag{6}$$

Sovereign Case:
Investment Grade

$$r_T \leq r \leq r_S; \frac{r - r_T}{r_S - r_T} = 0.60154; \tag{7}$$

Speculation Grade

$$r \leq r_T \leq r_S; \frac{r - r_T}{r_S - r_T} = -0.66847. \tag{8}$$

To look for the reasons behind these difference, I outline the rating-specific implied benchmark at Table 5. Hull et al.(2004) observe the implied rate rises when rating is declining. They explain this phenomenon only partially by the counterpart default risk in a CDS, and accept the existence of other factors. While, in sovereign case, I find the opposite result– the implied rate is declining with rating. The explanation with the counterpart default risk in Hull et al.(2004) therefore can not apply. This also shows traditional factors in reasoning the behavior of CDS market are very limited.

Table 5: Comparison Table

	Rating	r-r_T		r-r_S		No.
		Mean	S.E.	Mean	S.E.	
Sovereign Bond Case						
Korea	A-	0.621364	0.0125609	-0.08167	0.0104588	247
South Africa	BBB	0.458158	0.02095	-0.1797	0.02013	144
Mexico	BBB-	0.254863	0.0122359	-0.46618	0.0174240	334
Investment Grade	——-	0.42011	0.0102	-0.27828	0.01167	725
Egypt	BB+	0.16208	0.05497	-0.4623	0.04844	104
Russia	BB	-0.05197	0.0204105	-0.8058	0.0222210	374
Brazil	BB-	-0.70571	0.0221534	-1.49305	0.0200528	452
Venezuela	B	-0.99163	0.0863562	-0.68884	0.0869170	282
Argentina	D	-11.7831	0.9739806	-12.5745	0.9709332	464
Speculation Grade	——-	-0.49604	0.02596	-1.23809	0.02602	1212
Pool	——-	-0.15313	0.01949	-0.87884	0.01989	1937
John Hull's case						
	AAA/Aa	0.5130	0.0197	-0.0955	0.0131	
	A	0.6433	0.0182	-0.0583	0.0159	
	BBB	0.8493	0.0363	-0.0221	0.0279	
	Pool	0.6287	0.0138	-0.0651	0.0106	

6.2 Why implied benchmark is less than US treasury?

According to the calculation formula of the implied benchmark, its relevant position to US treasury is actually driven by the relationship of yield spread and CDS rate.[8]. When bond yield exceed CDS, meaning that buying default risk insurance in CDS market is cheaper, the implied benchmark will be greater than US treasury; when bond yield is less than CDS, meaning that hedging default risk at bond market is cheaper, the implied benchmark will be less than US treasury. When a borrower's credit quality declines, both yield spread and CDS rate will rise. If they both act by the same pace and magnitude, that will not affect the relationship of implied benchmark with US treasury. But, when they do not act at the same style, the relationship will be influenced; this is exact the fact I have observed from the date: CDS rate rises faster when credit quality of borrowers decaying. The study of the relationship of implied benchmark and treasury yield, then returns back to the relationship of yield spread and CDS rate, which is the most fundamental relationship of these two markets.

[8] Yield spread is defined by the yield of defaultable bond over US treasury yield, represents the default risk premium in bond market

6.3 Why CDS is higher than yield spread?

6.3.1 Graphic relation

The comparison of yield spread and CDS rate is illustrated by Figure 1-4. Graphs in Figure 1 are about sovereigns at investment grade: Korea, South Africa and Mexico. CDS rate is consistently lower than yield spread, and a price gap is clearly observed. But the price gap seems converging and diminishing at later's trading dates, especially in Mexico. Only one upgrade rating event is in Mexico on Feb. 2002 during sample period, but the gap started converging 10 months earlier and diminished 4 months earlier than the rating even. So, rating change is not the reason to the price convergence in Mexico.

Figure 2-4 list sovereigns at speculation grade. Egypt's CDS is very illiquid, the price gap does not shrink. The value of CDS exceeds yield spread since March 2002, two months before its rating downgrade, which may imply a market preadjustment. In Russia and Venezuela, CDS is below yield spread at starting date, and beyond it from the middle of year 2001. Compared with investment grade, price differences in speculation grade are much smaller, and CDS curves are more smooth, showing improvement of liquidity. In Brazil, CDS is very liquid and consistently higher than yield spread. But the price difference converges from time to time, showing more integration of two markets. Argentina has exceptional data since 2002, CDS firstly jumps to 14000bps, then drops to 10000bps level. The jumps in CDS is ahead of yield spread during this pre-default period, behaving as a leading indicator.

6.3.2 Regressive relation

Using sovereign-specific linear regressions, the overall correlation of CDS and yield spread is outlined at Table 13 and 14. These regressions are better fit and more significant than previous ones. Results on Egypt and South Africa are insignificant due to illiquid CDS.

The estimates of intercept are insignificantly different from zero, and coefficient estimates of CDS rate vary from 0.8 to 1.4, except Egypt and South Africa. Where, the estimates at investment grade are greater than 1, showing the yield spread is statistically higher than CDS rate; estimates at speculation grade are less than 1.

6.3.3 An explanation by market demand and supply

Blanco et al.(2004) discuss that CDS is the upper bound and yield spread is the lower bound of credit risk premium, implying CDS should be analytical higher than yield spread. Where, Hull et al.(2004)'s study suggests an opposite measure.

Possible reasons driving each of these situations are: the difference in liquidity across market, and/or the difference in market demands. Based on my data, liquidity reason is excluded, although it can explain the convergence of the prices. Lower liquidity in CDS combines with both higher and lower CDS rate in the case of Egypt. Instead, the consistent high CDS at speculation grade suggests a more important reason: the increase of market demand in CDS market to insure default drives up the price and make CDS more expensive to buy. This also show the preference of market participants on CDS market when they really want to hedge their risk exposures on the bonds at speculation grade. The increasing demand for, therefore, pulls up the CDS price.

7 Conclusion

According to the discussions in previous sections, I conclude the following points:

1. US treasury is a better approximation of the implied default-free rate in sovereign CDS market than LIBOR;

2. CDS rate at speculation grade are generally beyond yield spread;

3. Increasing market demand for CDS on sovereigns at lower rating drives CDS up;

4. Liquidity results in price convergence;

5. Rating events causes diverging behavior on CDS and bond markets at speculation grade.

Some of these findings may raise up new interests and open new research areas in the future, since more dynamic study is needed to firm a more solid support to these points.

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Table 6: Data Interpolation Record–(07/22/2004)

country	bond1	maturity1	bond2	maturity2	bond3	maturity3
Argentina	$Arge-FRB$	3/29/2005	$Arge-09$	4/7/2009	—	—
Brazil	$Brazil-04$	4/15/2004	$Brazil-07$	7/26/2007	$Brazil-09$	10/15/2009
China	$China-04$		$China-08$	12/15/2008	$China-11$	5/23/2011
Egypt	$Egypt-06$	7/11/2006	$Egypt-11$	7/11/2011	—	—
Israel	$IsraelE-06$	6/16/2006	$Israel-10$	3/15/2010	—	—
Korea	$KDB06$	5/15/2006	$Kor-08$	4/15/2008	—	—
Mexico	$Mex-05$	4/6/2005	$Mex-07$	1/15/2007	$Mex-11$	1/14/2011
Russia	$RUS-03$	6/10/2003	$RUS-07$	6/26/2007	$RUS-10$	3/31/2010
South Africa	$SOAF-06$	10/17/2006	$SOAF-09$	5/19/2009	—	—
Venezuela	$Vene-07$	6/18/2007	$Vene-NMB-05$	12/18/2005	—	—

Table 7: Regressions on various benchmarks (Korea)

Constant	-0.0421	0.11932	-0.6695	-0.5189
		(*0.324*)		
SE of Constant	0.14548	0.1208	0.13239	0.13268
Coef of r_T	1.15126	1.13866	———	———
SE of coef.	0.03305	0.02726	———	———
Coef of r_S	———	———	1.11552	1.09416
SE of coef.	———	———	0.02594	0.02556
Coef of q	———	-36.41	———	-14.383
SE of coef	———	3.36867	———	3.35789
SE of Residual	0.18986	0.15645	0.15842	0.15309
Adjusted R^2	0.8313	0.8854	0.8825	0.8903

Table 8: Regressions on different benchmarks (Mexico)

Constant	-0.9802	-0.9415	0.51655	0.58428
SE of Constant	0.1359	0.12073	0.17595	0.17806
Coef1 of r_T	1.27576	1.27781	———-	———-
SE of coef1	0.03024	0.02685	———-	———
Coef2 of r_S	———	———	0.81101	0.80146
SE of coef2	———-	———	0.03369	0.03383
Coef3 of q	———	-66.99	———	-25.312
SE of coef3	———	7.05664	———	12.1458
SE of Residual	0.20028	0.17783	0.30479	0.30327
Adjusted R^2	0.8423	0.8757	0.6347	0.6384

Table 9: Regressions on various benchmarks (Brazil)

Constant	-3.43403	-3.57299	-2.842635	-1.91951
SE of Constant	0.100982	0.20316	0.1259903	0.230524
Coef of r_T	1.568426	1.591228	———	———
SE of coef.	0.020847	0.035657	———	———
Coef of r_S	———	———	1.241553	1.114136
SE of coef.	———	———	0.0223218	0.034632
Coef of q	———	6.935808	———	-49.6303
SE of coef	———	8.797618	———	10.47901
SE of Residual	0.28953	0.28965	0.38019	0.37145
Adjusted R^2	0.9262	0.9261	0.8727	0.8785

Table 10: Regressions on r_T (Russia)

		total change	rating change	outlook change
Constant	-1.57786	-1.81975	-1.791772	-1.06155
SE of Cons	0.181087	0.202933	0.1829831	0.206911
Coef of r_T	1.332425	1.361092	1.344793	1.236896
SE of coef	0.03924	0.040517	0.0383731	0.043127
Coef of q	———-	9.296025	15.72242	-41.5878
SE of coef	———-	3.620474	3.513826	8.755815
SE of Residual	0.36188	0.35919	0.35297	0.35183
Adjusted R^2	0.7554	0.759	0.7673	0.7688

Table 11: Regressions on various benchmarks (Venezuela)

Constant	-6.76807	-7.06632	-3.808003	-3.70939
SE of Constant	0.996918	0.985814	0.8929995	0.895296
Coef of r_T	2.305372	2.404267	———	———
SE of coef.	0.224527	0.223211	———	———
Coef of r_S	———	———	1.413709	1.406151
SE of coef	———	———	0.1735201	0.173422
Coef of q	———	-88.3867	———	-37.9842
SE of coef	———	27.96347	———	29.65481
SE of Residual	1.3723	1.3508	1.4476	1.4459
Adjusted R^2	0.2709	0.2936	0.1887	0.1906

Table 12: Regressions on r_T (Argentina)

	Not added	Total change	Rating change	Outlook change
Constant	-70.977	-21.1301	64.25671	-116.47
		(0.159)		
SE of Cons	6.443582	14.97999	13.04487	8.510645
Coef of r_T	13.25201	5.417936	-8.747957	19.58147
		(0.031)		
SE of coef1	1.320765	2.498528	2.237399	1.49632
Coef of q	———	-657.512	-2660.512	1372.015
SE of coef	———	178.9141	230.9909	179.6761
SE of Residual	19.284	19.028	17.011	18.188
Adjusted R^2	0.1771	0.1988	0.3596	0.2679

Table 13: Regressions of Yield Spread on CDS Rate

	Pool of Six	Argentina	Egypt	Korea	Mexico	Russia	South Africa
Constant	0.01097	0.019761	0.024375	0.002735	0.000317	-0.0068	0.014213
SE of Cons.	0.001553	0.006671	0.000876	0.000444	0.000697	0.000728	0.002742
Coef of CDS	0.841371	0.830944	0.10169	1.417557	1.111512	1.118144	0.52008
SE of coef	0.005108	0.011664	0.034368	0.049779	0.028763	0.009607	0.141073
SE of Residual	0.05731	0.10821	0.00199	0.00177	0.00223	0.00384	0.00242
Adjusted R^2	0.9422	0.9164	*0.07*	0.767	0.8176	0.9732	*0.0809*
No. of obs	1667	464	104	247	334	374	144

Table 14: Regressions of CDS Rate on Yield Spread

	Pool of Six	Argentina	Egypt	Korea	Mexico	Russia	South Africa
Constant	-0.00475	0.009595	0.003925	0.000523	0.004108	0.00787	0.015306
SE of Cons	0.001815	0.007745	0.007088	0.000293	0.000521	0.000585	0.001113
Coef of spread	1.119829	1.103044	0.77734	0.541763	0.736038	0.870437	0.16796
SE of coef	0.006798	0.015483	0.262714	0.019025	0.019047	0.007479	0.045559
SE of Residual	0.06612	0.12468	0.00551	0.00109	0.00182	0.00339	0.00137
Adjusted R^2	0.9422	0.9164	0.07	0.767	0.8176	0.9732	0.0809
No. obs	1667	464	104	247	334	374	144

Table 15: Foreign Currency Sovereign Credit Rating History

Sovereign	Date	Long Term/ Outlook/Short Term
Argentina (Republic of)	Feb. 12, 2002	SD/NM/SD
	Nov. 6, 2001	SD/NM/C
	Oct. 30, 2001	CC/Negative/C
	Oct. 9, 2001	CCC+/Negative/C
	Jul. 12, 2001	B-/Negative/C
	Jun. 6, 2001	B/Negative/C
	May. 8, 2001	B/CW-Neg./C
	Mar. 26, 2001	B+/CW-Neg./B
	Mar. 19, 2001	BB-/CW-Neg./B
	Nov. 14, 2000	BB-/Stable/B
	Oct. 31, 2000	BB/CW-Neg./B
	Feb. 10, 2000	BB/Stable/B
	July. 22, 1999	BB/Negative/B
Brazil (Federative Republic of)	Jul. 2, 2002	B+/Negative/B
	Aug. 9, 2001	BB-/Negative/B
	Jan. 3, 2001	BB-/Stable/B
	Feb. 29, 2000	B+/Positive/B
	Nov. 9, 1999	B+/Stable/B
	Jan. 14, 1999	B+/Negative/B
Egypt (Arab Republic of)	May 22, 2002	BB+/Stable/B
	Jun. 22, 2001	BBB-/Negative/A-3
	Jul. 3, 2000	BBB-/Negative/A-3
	Jan. 15, 1997	BBB-/Stable/A-3
Korea (Republic of)	24-Jul-02	A-/Stable/A-2
	Nov. 13, 2001	BBB+/Stable/A-2
	Nov. 11, 1999	BBB/Positive/A-3
	Jan. 25, 1999	BBB-/Positive/A-3
	Jan. 4, 1999	BB+/Positive/B
United Mexican States	Feb. 7, 2002	BBB-/Stable/A-3
	March 10, 2000	BB+/Positive/B
	Sept. 2, 1999	BB/Positive/B
Russian Federation (The)	Dec. 5, 2002	BB/Stable/B
	Jul. 26, 2002	BB-/Stable/B
	Feb. 22, 2002	B+/Positive/B
	Dec. 19, 2001	B+/Stable/B
	Oct. 4, 2001	B/Positive/B
	Jun. 27, 2001	B/Stable/B
	Dec. 8, 2000	B-/Stable/C
	Jul. 27, 2000	SD/NM/SD
	Feb. 15, 2000	SD/NM/SD
	May. 7, 1999	SD/NM/SD
South Africa (Republic of)	7-May-03	BBB/Stable/A-3
	Nov. 11, 1999	BBB/Positive/A-3
	Jan. 25, 1999	BBB-/Positive/A-3
	Jan. 4, 1999	BB+/Positive/B
Venezuela (Bolivarian Republic of)	Dec. 13, 2002	CCC+/Negative/C
	Sept. 23, 2002	B-/Negative/C
	Mar. 18, 2002	B/Negative/B
	Feb. 11, 2002	B/CW-Neg./B
	Dec. 21, 1999	B/Stable/B

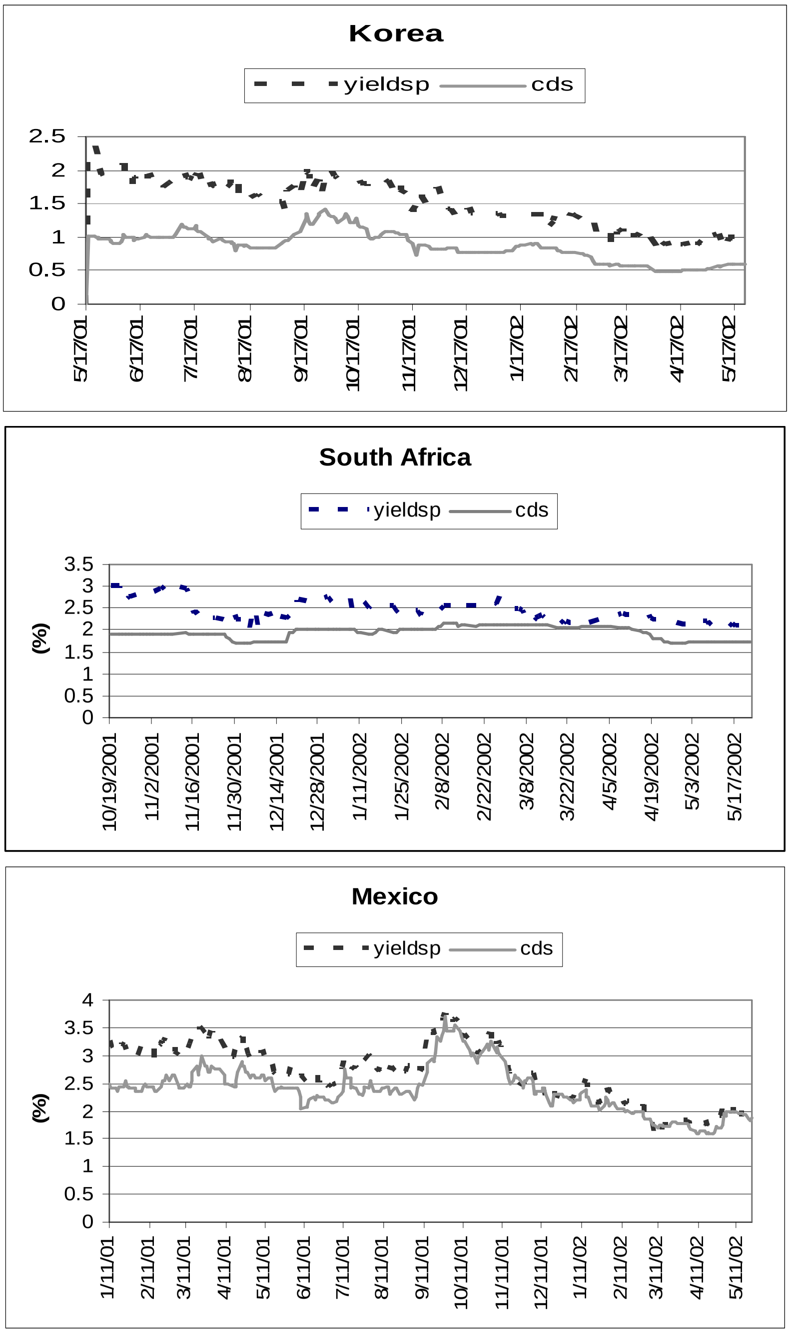
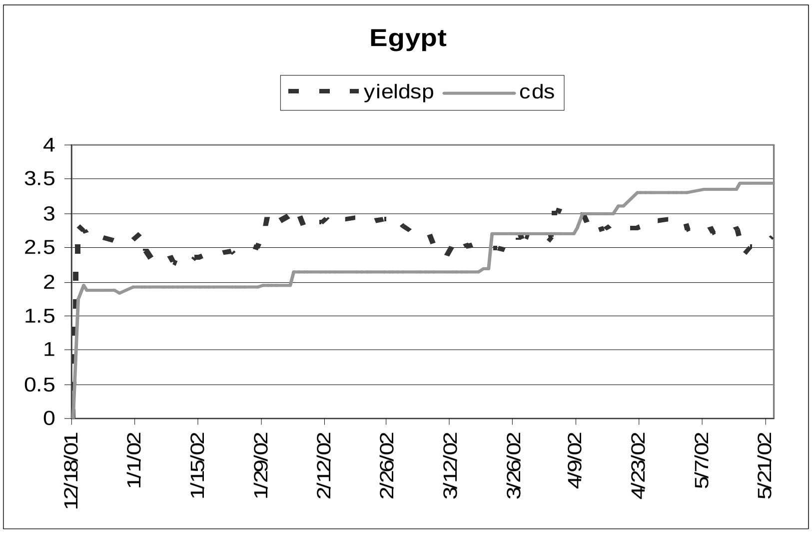


Figure 1: Investment Grade Sovereigns



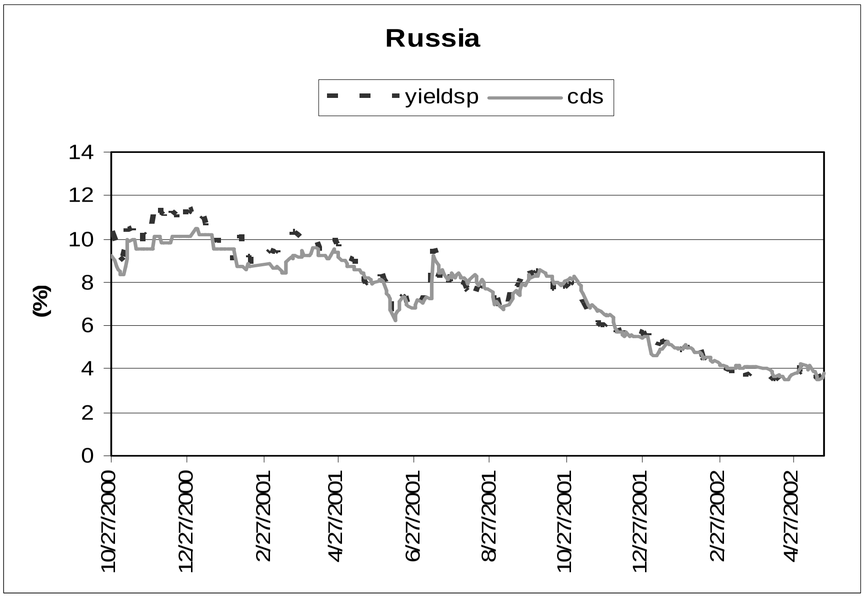
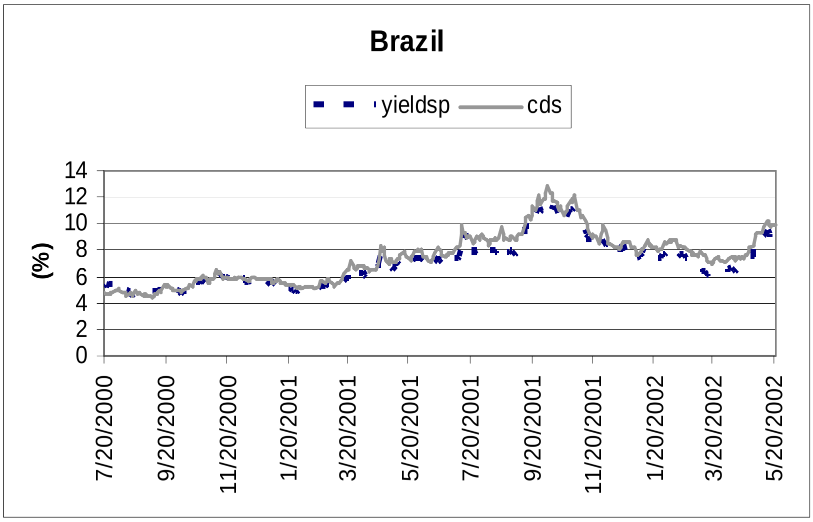


Figure 2: Speculation Grade Sovereigns



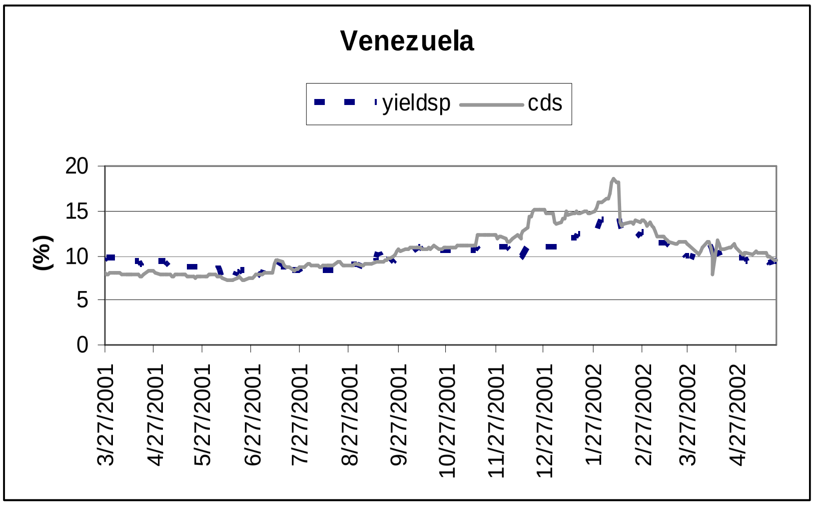


Figure 3: Speculation Grade Sovereigns

Figure 4: Speculation Grade Sovereigns