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Anticipating Credit Events Using Credit Default Swaps, with an Application to Sovereign Debt Crises

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International Capital Markets Department

Anticipating Credit Events Using Credit Default Swaps, with an Application to Sovereign Debt Crises[1]

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Abstract

In reduced-form pricing models, it is usual to assume a fixed recovery rate to obtain the probability of default from credit default swap prices. An alternative credit risk measure is proposed here: the *maximum recovery rate* compatible with observed prices.
The analysis of the recent debt crisis in Argentina using this methodology shows that the correlation between the maximum recovery rate and implied default probabilities turns negative in advance of the credit event realization. This empirical finding suggests that the maximum recovery rate can be used for constructing early warning indicators of financial distress.

JEL Classification Numbers: G0, G15

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I. Introduction

Credit derivatives are derivative securities with payoffs contingent on the realization of a credit event, such as default on a reference bond or a ratings downgrade of a reference entity below a threshold level agreed in the contract. Because these instruments isolate credit risk from other sources of risk, such as market risk and operational risk, they can be used for transferring credit risk from one party to another at a relatively low cost. Market prices of these instruments, especially credit default swaps (CDS), should reflect market assessments of the likelihood of the credit event and the expected value of the reference security after the credit event.

Conceptually, a credit default swap can be interpreted as purchasing insurance against the risk of default on a reference security. Hence, the price of a credit default swap is a function of both the probability of default of the issuer and the post-default expected recovery value. In reduced-form pricing models it is usually assumed that the recovery rate is equal to a fixed fraction of par value or market value of the reference security. Given a cross-section of credit default swap prices for different maturities and a fixed recovery rate, it is possible to extract the corresponding default probabilities by reverse-engineering the pricing model given credit default swap prices.

This paper proposes an alternative risk measure: the *maximum recovery rate* or upper bound on feasible recovery rates that match the cross-section of CDS spreads. For policy-making and risk management purposes, the use of the maximum recovery rate provides the most conservative estimate of the probability that the issuer will default on the reference security. Indeed, CDS spreads are uniquely determined by the magnitude of expected losses. For a given CDS spread, higher recovery rates imply higher default probabilities. Using the maximum recovery rate, hence, delivers the maximum default probability.

When the maximum recovery rate methodology is applied to cross-sectional time series data on credit default swap prices on Argentina's sovereign bonds, a remarkable empirical pattern emerges. During normal periods, the maximum recovery rate and implied default probabilities exhibit positive correlation. However, the correlation turns sharply negative in advance of the default event. This finding suggests that the joint behavior of the maximum recovery rate and implied default probabilities can be used to anticipate credit events.

The rest of the paper is structured as follows. Section II provides useful background information on the credit derivatives market and credit default swaps, and explains why default swaps spreads may help to forecast credit events. This section may be skipped by the reader already familiar with the credit derivatives market and the instruments. Section III explains how to obtain the maximum recovery rate and corresponding default probabilities with cross-section data on credit default swaps. While this method is tailored to a specific pricing model (Duffie, 1999), it can be easily adapted to different CDS pricing models. Section IV applies the maximum recovery rate methodology to the recent Argentina debt crisis. It also analyzes contagion in Latin America during the crisis episode. Section V compares the behavior of CDS spreads and bond spreads during the Argentina debt crisis. Section VI concludes.

II. Background

This section introduces some facts about the credit derivatives market and describes in detail the main characteristics of credit default swaps. Although credit default swaps are not the only credit derivatives available in the market, their relative simplicity and increased contract standardization have rapidly made them the "plain vanilla" contract in the credit derivatives universe.[2] Furthermore, standardization makes prices comparable across issuers and sectors at different aggregation levels, facilitating relative credit risk assessment.

A. The Credit Derivatives Market

Credit derivatives provide corporations, financial institutions, and institutional investors with flexible tools to create synthetic risk exposure tailored to their specific needs. It is not surprising, then, that the use of credit derivatives has accelerated since the market inception in 1993. By the end of 2002, the credit derivatives market accounted for only 2 percent to 3 percent of the $100 trillion derivatives market. However, its growth has been nothing but spectacular.

According to the British Bankers' Association's 2002 survey,[3] the credit derivatives market increased more than five-fold to $1,189 billion by the end of 2001 from $180 billion by the end of 1997. The BBA survey suggest that the market has doubled to $1,952 billion by end-2002, in line with recent estimates reported in the 2002 International Swaps and Derivatives Association (ISDA) survey, and that will grow to $4,799 billion by end-2004. Emerging market issuers comprised a small share of the global credit derivatives market. As of mid-2001, estimates range from a low of $40 billion to $200-300 billion, roughly between 4 to 20 percent of the credit derivatives market.[4]

B. Credit Default Swaps

Credit default swaps are the most liquid instruments in the credit derivatives markets, accounting for nearly half of the total outstanding notional worldwide, and up to 85 percent of total outstanding notional of contracts with reference to emerging market issuers. In a credit default swap, the protection buyer pays a premium to the protection seller in exchange

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[2] See Tavakoli (1998) for descriptions and examples of other credit derivatives contracts such as total return swaps, credit spread options, and credit-linked notes, among others.

[3] British Bankers' Association, 2002, *Credit Derivatives Report 2001/2002*.

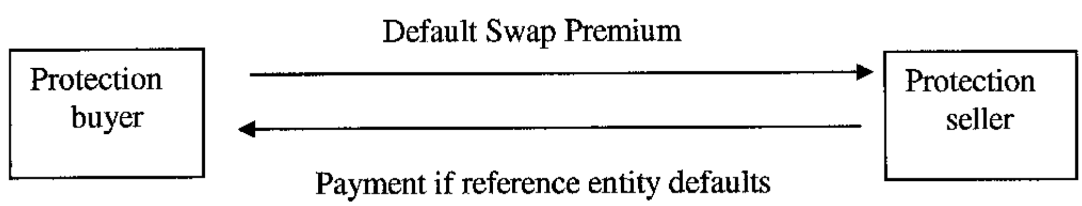
[4] See IMF (2002b), Chapter IV, for a comprehensive discussion of derivatives markets in emerging markets, including credit derivatives.

for a contingent payment in case a credit event involving a reference security occurs during the contract period (Figure 1).[5]

The premium (default swap spread) reflects the credit risk of the bond issuer, and is usually quoted as a spread over a reference rate such as LIBOR or the swap rate, to be paid either upfront, quarterly, or semiannually. The contingent payment can be settled either by physical delivery of the reference security or an equivalent asset, or in cash. With physical settlement, the protection buyer delivers the reference security (or equivalent one) to the protection seller and receives the par amount. With cash settlement, the protection buyer receives a payment equal to the difference between par and the recovery value of the reference security, the latter determined from a dealer poll or from price quote services. Contracts are typically subject to physical settlement. This allows protection sellers to benefit from any rebound in prices caused by the rush to purchase deliverable bonds by protection buyers after the realization of the credit event.

In mature markets, trading is highly concentrated on five-year contracts, and to certain extent, market participants consider these contracts a "commodity." For emerging markets issuers, CDS are available for a relatively large number of sovereigns and some selected corporations. Usual contract maturities are 1, 2, 5, and 10 years.

Figure 1. Credit Default Swap



C. The Default Swap Basis[6]

The coexistence of markets for default swaps and bonds raises the issue on whether prices in the former merely mirrors market expectations already reflected in bond prices. Absent market frictions, if credit risk were the only factor affecting the CDS spread, with credit risk

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[5] The 1999 ISDA Credit Derivatives Definitions include the following six types of credit event: (1) bankruptcy; (2) failure to pay; (3) restructuring; (4) repudiation/moratorium (for a sovereign entity); (5) obligation default; and (6) obligation acceleration.

[6] See Marsh (2002) for an in-depth discussion of the default swap basis. Rieu (2001) conducts an empirical investigation of what factors underlie basis changes for France Telecom both in time and along the term structure. Rule (2001) and IMF (2002a) analyze the financial stability implications of credit derivatives markets.

characterized by the probability of default and the expected loss given default, the CDS spread and the bond spread should be approximately similar, as a portfolio of a default swap contract and a defaultable bond is essentially a risk free asset.[7]

However, market frictions and some embedded options in the CDS contract, such as the cheapest-to-deliver option, cause CDS spreads and bond spreads to diverge. The difference between these two spreads is referred to as the *default swap basis*. The default swap basis is positive when the CDS spread trades at a premium relative to the bond spread, and negative when the CDS spread trades at a discount. For ease of reference, the text will refer to the default swap basis simply as basis henceforth. Reasons behind movements in the basis are explained in detail next.

Several factors contribute to the *widening of the basis*, either by widening the CDS spread or tightening the bond spread. Factors that tend to *widen the CDS spread* include: (i) the *cheapest-to-deliver option*, since protection sellers must charge a higher premium to account for the possibility of being delivered a less valuable asset in physically settled contracts;[8] (ii) the *issuance of new bonds and/or loans*, as increased hedging by market makers in the bond market pushes up the price of protection, and the number of potential cheapest-to-deliver assets increases; (iii) the ability to *short default swaps rather than bonds* when the bond issuer's credit quality deteriorates, leading to increased protection buying in the market; and (iv) *bond prices trading less than par*, since the protection seller is guaranteeing the recovery of the par amount rather than the lower current bond price.

Factors that tend to *tighten bond spreads* include: (i) bond clauses allowing the *coupon to step up* if the issue is downgraded, as they provide additional benefits to the bondholder not enjoyed by the protection buyer; and (ii) the *zero-lower bound* for default swap premiums causes the basis to be positive when bond issuers can trade below the Libor curve, as is often the case for higher rated issues.

Similarly, factors that contribute to the *tightening of the basis* include: (i) existence of greater *counterparty risk* to the protection buyer than to the protection seller, so buyers are compensated by paying less than the bond spread; (ii) the removal of *funding risk* for the protection seller, as selling protection is equivalent to funding the asset at Libor. Less risk demands less compensation and hence, a tightening in the basis; and (iii) the *increased supply of structured products* such as CDS-backed Collateralized Debt Obligations (CDOs), as they increase the supply of protection in the market.

Movements in the basis depend also on whether the market is mainly dominated by high cost investors or low cost investors. A long credit position, i.e. holding the credit risk, can be

[7] Duffie (1999) and Hull and White (2000) formalize these arguments for floating par notes and analyze several extensions.

[8] This option ameliorates the pricing abnormalities that may arise when the number of CDS contracts outstanding exceeds the number of the reference bond in the contract.

obtained either by selling protection or by financing the purchase of the risky asset. The CDS remains a viable alternative if its premium does not exceed the difference between the asset yield and the funding cost. The higher the funding cost, the lower the premium and hence, the tighter the basis. Thus, when the market share of low cost investors is relatively high and the average funding costs are below Libor, the basis tends to widen.

Finally, relative liquidity also plays a role in determining whether the basis narrows or widens, as investors need to be compensated by wider spreads in the less liquid market. Hence, if the CDS market is more liquid than the corresponding underlying bond market (cash market), the basis will narrow and vice versa.

D. Credit Default Swap Spreads and Credit Events

An analysis of the factors affecting the default swap basis provides an understanding on why CDS spreads react more strongly than bond spreads to a perceived deterioration of the credit quality of the issuer. For example, if shorting the bond is difficult, the buildup of short positions on the credit takes place in the CDS market through increased protection buying. In consequence, the price of protection, as measured by the CDS spread, rises. Coupon step-ups clauses also become active when the credit deteriorates, and could further widen the CDS spread. If there is market segmentation, relative value trading between the CDS market and the bond market may not take place to arbitrage the basis widening away.

During periods of distress, for mature markets liquidity in the underlying bond market may dry out while trading in the CDS market continues. Indeed, as noted by Fleming and Garbade (2002), in the aftermath of the events of September 11, 2001, price discovery migrated from the bond market to the CDS market, as a result of the serious disruption in the underlying bond market clearing mechanisms.[9] For emerging markets issuers, the number of protection buyers increases relative to the number of protection sellers in the CDS market. Excess demand leads to higher CDS spreads. In the underlying bond market, imbalances between demand and supply are not as pronounced, so bond spreads do not increase as much as CDS spreads.

When CDS with different maturities are traded in the same date, it is possible to construct a CDS term structure or CDS spread curve, a plot of CDS spreads against maturities. The CDS spread curve is normally upward sloping for creditworthy bond issuers: credit risk for a high quality issuer is not likely to deteriorate in the near term and explains why CDS spreads are

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[9] A widening of spreads does not necessarily reflect a fundamental deterioration of the credit quality of the bond issuer. Investment policy constraints requiring institutional investors to hold only investment-grade issues may cause speculators to build up substantial short positions on an investment-grade reference issue, either through the cash market or the CDS market, in the expectation that the ensuing widening of spreads and decline in equity prices would prompt a rating downgrade to non-investment grade. Once the reference issue is downgraded, the forced sell-off allows short-sellers to cover their positions profitably.

low for relatively short maturities. As time passes, credit quality deterioration is more likely than credit quality improvements, i.e. the only rating movement for an AAA-rated issuer is downwards, and this is reflected in higher CDS spreads as maturity increases.

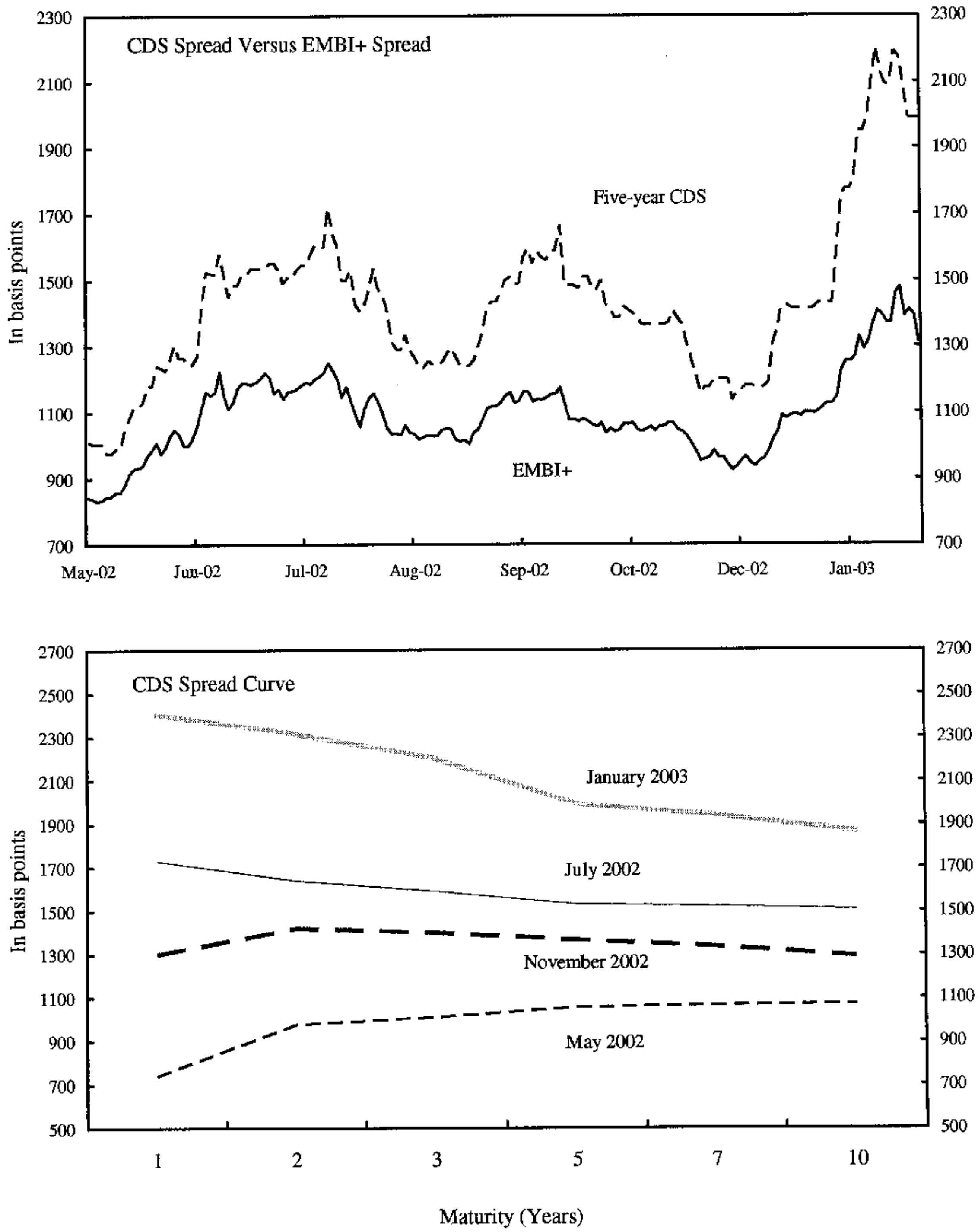
For lower-rated bond issuers, or bond issuers undergoing severe distress, the CDS spread curve can invert with short-term CDS spreads higher than long-term CDS spreads. Merton (1974) was among the first to explain this behavior, modeling it formally in an option-based framework. The intuition behind the curve inversion is simple: default risk for this class of issuers is very high in the near term, but it is believed that once the current difficulties are overcome, chances are that the bond issuer would be able to meet its obligations. Hence, default risk in the medium and long term is lower than in the near term, and is reflected in the downward slope of the CDS spread curve.

The recent behavior of CDS spreads on Venezuela U.S. dollar-denominated sovereign debt is illustrative of the points discussed above (Figure 2). While the five-year CDS spread and the EMBI+ spread for Venezuela exhibit high correlation, the response of the CDS spread response to instability episodes in July 2002 and October 2002, and especially in January 2003, was stronger than the EMBI+ spread response.

During early 2002, the CDS spread curve shown in this figure exhibited an upward sloping shape. Increased market concerns about sovereign default risk caused the CDS spreads to widen all along the curve, but even more in the short end of the curve. As a result, the curve inverted in July 2002. The second half of 2002 though, was a relatively tranquil period, and both bond spreads and CDS spreads compressed by around 300 to 500 basis points. Fears that Venezuela could default in the immediate future diminished, as reflected in the fact that most of the compression took place in the short end of the curve. However, tranquility did not last long, as the political landscape in Venezuela deteriorated rapidly in January 2003. Again, there was a substantial widening of spreads, and the CDS swap curve inverted again.

More specific information on markets' expectations of default can be extracted from CDS prices. Namely, CDS pricing models can be used to recover default probabilities and recovery rates, providing an intuitive metric to assess an issuer's creditworthiness. The next section describes a methodology to extract two credit risk measures, the maximum recovery rate and its implied default probabilities, from CDS spreads.

Figure 2. Venezuela: Developments in the CDS Market



III. Maximum Recovery Rate and Implied Default Probabilities

While some CDS pricing models are relatively complex, they rely on a simple foundation: at inception, the value of the default swap should be the same for both the buyer and seller or protection. The *premium leg* of the contract, payable to the protection seller, is the expected present value of premium payments either until the contract matures or the issuer defaults, whichever comes first. The *default leg,* payable to the protection buyer in case of default, is the expected present value of the loss given default before the maturity of the contract. The CDS spread is such that both legs are equally valued. Clearly, the term structure of default probabilities and the recovery rate are important inputs to price both legs of the contract.

The interrelationship between these two elements is described in the context of the CDS pricing model of Duffie (1999). His model assumes that the time to maturity of the CDS, T, is equally divided into n periods with length T/n. The CDS spread, S, is paid at the end of every period at time $t(i)=iT/n$, $i=1,..,n$. Default can take place at any time. In case of default between times $t(i)$ and $t(i+1)$, the CDS is settled in period $t(i+1)$, with the protection seller paying the loss value of the defaulted security $F(1-RR)$, where F is the notional value of the CDS contract, and RR is the recovery rate. For simplicity, it is assumed that the notional value of the contract, F, is unity.

The probability of survival is summarized by the term structure of hazard rates or default intensities, $\lambda=\{\lambda(i)\}$, $i=1,..,n$. Thus, the probability of surviving until period $t(i)$ given no default in period $t(i-1)$ is given by $\exp[-\lambda(i)\times(t(i)-t(i-1))]$, and the probability of survival until period $t(i)$ is simply:

(1) $$p(t(i))=\exp\left(-\sum_{k=1}^{i}\lambda(k)\times(t(k)-t(k-1))\right)=\exp\left[\frac{1}{i}\left(-\sum_{k=1}^{i}\lambda(k)\right)t(i)\right].$$

Denote by $a(i)$ the value at time 0 of receiving one unit at time $t(i)$ when default occurs at $t>t(i)$. This value is equal to the probability of surviving until time $t(i)$ discounted to time 0 by the default-free yield $y(i)$ corresponding to time $t(i)$:

(2) $$a(i)=\exp\left[-\left(\frac{1}{i}\sum_{k=1}^{i}\lambda(k)+y(i)\right)t(i)\right].$$

The premium leg, then, can be expressed as:

(3) $$A(\lambda,T)S=S\sum_{i=1}^{n}a(i).$$

Similarly, denote by $b(i)$ the value at time 0 of receiving one unit at time $t(i)$ if default occurs between times $t(i-1)$ and $t(i)$. Let τ be the default time. The probability of default in the interval $]t(i-1),t(i)]$ is given by:

$$(4) \qquad P(t(i-1) < \tau < t(i)) = \exp\left[-\left(\frac{1}{i-1}\sum_{k=1}^{i-1}\lambda(k)\right)t(i-1)\right] - \exp\left[-\left(\frac{1}{i}\sum_{k=1}^{i}\lambda(k)\right)t(i)\right],$$

and the value of $b(i)$ at time 0 is:

$$(5) \qquad b(i) = \exp(-y(i)t(i)) \times P(t(i-1) < \tau < t(i)).$$

The default leg can be expressed as:

$$(6) \qquad B(\lambda, T)(1-RR) = (1-RR)\sum_{i=1}^{n} b(i).$$

Equalizing the values of the premium and default legs yields the following formula for the CDS spread, S, given the term structure of default intensities, time to maturity, and recovery rate:

$$(7) \qquad S(\lambda, T, RR) = B(\lambda, T)(1-RR) / A(\lambda, T).$$

Equation (7) allows reverse engineering the term structure of default intensities λ given a fixed recovery rate if the term structure of CDS spreads, or CDS spread curve, is known. Once λ is known, other defaultable contracts can be priced upon assuming a given recovery rate. Though it should be noted that different recovery rates imply different default probabilities, i.e. $\lambda = \lambda(RR)$, so an indeterminacy problem arises if the recovery rate is not fixed a priori. This problem is usually dealt with by using historical data on recovery rates. For example, Moody's reports periodically average one-year default rates and recovery rates for corporate obligors grouped by credit rating.

This study approaches the problem of determining the recovery rate and implied default probabilities from a different perspective. Rather than trying to pin down the recovery rate, the focus is placed on extracting the *maximum recovery rate*, the upper bound of feasible recovery rates, and their implied default probabilities from the CDS spread curve. Intuition suggests that using the maximum recovery rate provides conservative estimates of the probability that the issuer will default on the reference security. Because CDS spreads are uniquely determined by the magnitude of expected losses, higher recovery rates imply higher default probabilities. Thus, the maximum recovery rate delivers the highest feasible default probability. Intuition also suggests that the maximum recovery rate is likely to decline when the credit quality of the bond issuer is undergoing a serious deterioration. Indeed, the application of this methodology to historical data on CDS spread curves for Argentina, as described in the next section, validates this intuition.

Formally, the maximum recovery rate is defined as follows:

Definition (Maximum Recovery Rate). Given the CDS spread curve and the default-free yield curve for a set of maturities T, the *maximum recovery rate*, RRmax, is defined as:

$$RR\max = \sup\left(RR : S(\lambda(RR),t,RR) = \frac{B(\lambda(RR),t)(1-RR)}{A(\lambda(RR),t)}, \forall t \in T \right), \tag{8}$$

where $\lambda(RR\max)$ is its associated term structure of default intensities. Equation (8) can be solved using numerical methods. The default intensities can then be used for estimating the term structure of default probabilities using equation (1).

IV. Applications

A. Anticipating Sovereign Debt Crises: Argentina (2001-2002)

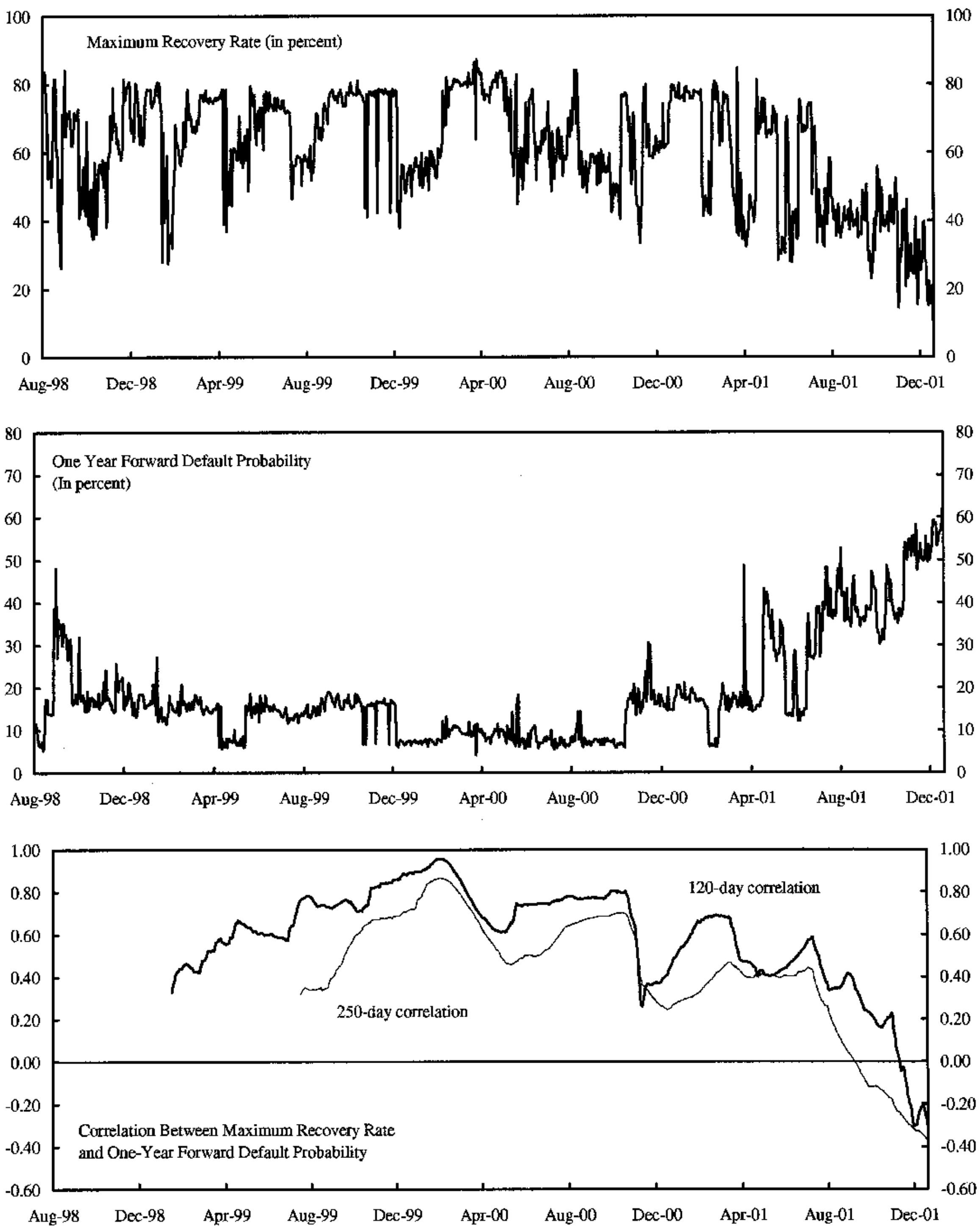
The recent default of Argentina on its sovereign debt in January 2002 provides an interesting case study for assessing the behavior of the maximum recovery rate and its associated default probabilities. The data used in this study include daily mid-point quotes of CDS spreads on Argentina sovereign debt for 1, 2, 3, 5, 7, and 10 year maturities during the period August 3, 1998 to December 12, 2001, and do not necessarily reflect transaction prices. Daily data on U.S. dollar swap rates was obtained from Primark Datastream.

The maximum recovery rate and the associated term structure of default intensities were obtained solving equation (8) using the CDS spread curve for each date in the sample. The day-to-day estimation approach is conceptually equivalent to the extraction of daily implied volatilities from cross-section of options at any given date. Therefore, it does not account explicitly for the possible interaction between CDS spreads and the default-free short rate, or the dynamic behavior of the recovery rate.[10] Figure 3 shows the maximum recovery rate, the one-year forward default probability obtained from the term structure of default intensities, and the correlation between these two quantities. Some observations are worth discussing in detail.

The first panel in Figure 3 shows the behavior of the maximum recovery rate for the sample period analyzed. The average maximum recovery rate was 62 percent, with a standard deviation of 16 percent. These estimates seem to be justified by past historical experience. For example, Beloreshki (2003) noted that countries that completed their Brady plan restructuring between 1989 and 2000 were forgiven 30 to 35 percent of its debt, or equivalently, the recovery rate was about 65 percent to 70 percent. In some instances, though, the debt write-off was around 50 percent (Poland in 1991 and 1994, and Bulgaria in 1994). Hurt and Felsovalyi (1998) estimated that, for the period 1970-1996, the average loss in the event of default for Latin American defaulted loans was on average 32 percent, that corresponds to an average recovery rate of 68 percent. On the other hand, the maximum recovery rate appears to overestimate the recovery rate of 25 percent of market value usually assumed by market participants in their estimates of credit risk (see Beloreshki, 2003).

[10] Ongoing work using dynamic term structure models addresses these shortcomings.

Figure 3. Argentina: Maximum Recovery Rate and Default Probability



The second panel in Figure 3 shows the evolution of one-year forward default probabilities. Increased concerns about Argentina's ability to roll over its maturing debt were evident by the end of 2000. Indeed, default probabilities increased above the average level of 1998-1999, though the provision of IMF assistance helped to allay markets' negative sentiment. After the second half of 2001, default probabilities increased steadily, though there was a brief respite during September-October 2001. However, the continued fiscal deterioration and a lack of credible economic programs pulled the country towards the brink of default by the end of 2001. In January 2002, Argentina defaulted on its external debt.

The relationship between the maximum recovery rate and the one-year forward default probability is illustrated in the last panel of Figure 3. Overall, the correlation tends to be positive during normal periods, and is inversely related to the level of default probability. Both the 120-day and 250-day correlations fell sharply starting October 2000, but they rebounded after the approval of the IMF aid package to Argentina in December 2000. However, correlations declined steadily from July 2001. The 250-day correlation turned negative as early as September 2001, well in advance of the sovereign default.

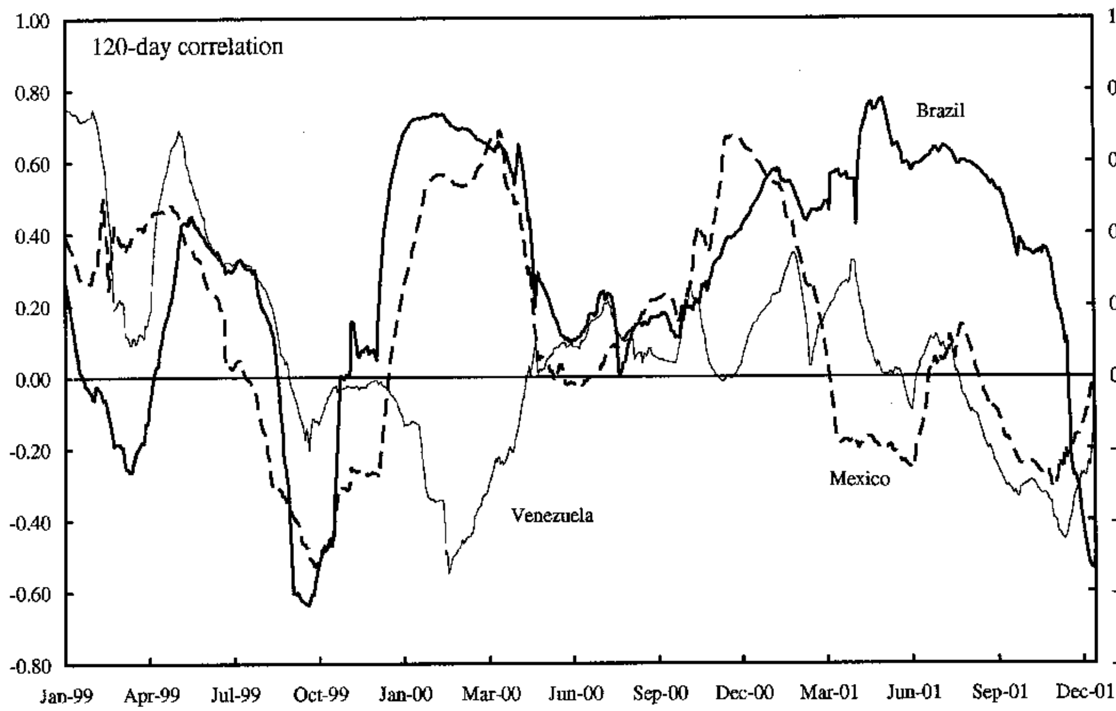
B. Contagion

One-year default probabilities associated to maximum recovery rate values can also be used to measure the degree of contagion between sovereign countries. Contagion in this context is defined as the extent to which credit events affecting one sovereign can influence market views on the creditworthiness of other sovereigns. Figure 4 shows one-year default probability cross-country rolling correlations with Argentina of different Latin American countries, including Brazil, Mexico, and Venezuela. The rolling correlations show that Brazil and Mexico experienced some spillovers from Argentina in the last quarter of 2000. The decoupling of Mexico and Brazil from Argentina occurred in early 2001 and the third quarter of 2001 respectively. Spillovers from Argentina to Venezuela were insignificant.

V. CDS SPREADS VS. BOND SPREADS

It is natural to inquire whether bond spreads and CDS spreads, and hence, the implied maximum recovery rate and default probabilities, contain the same information. Figure 5 shows that the EMBI+ stripped spread for Argentina were highly correlated during the sample period, with an average correlation of 0.94. However, the spread correlation declined substantially during the first half of 2000, and only returned to its average level in early 2001. Hence, it appears that CDS spreads contain some information beyond that already contained in bond spreads. Note that the additional information is not necessarily related to credit risk. Several of the technical factors affecting the basis described before may have caused the correlation breakdown without changes in default risk. Nevertheless, for both risk management and surveillance purposes, it is important to assess what factors underlie the breakdown of historical patterns.

Figure 4. Cross-Country Correlations with Argentina: One-Year Default Probability



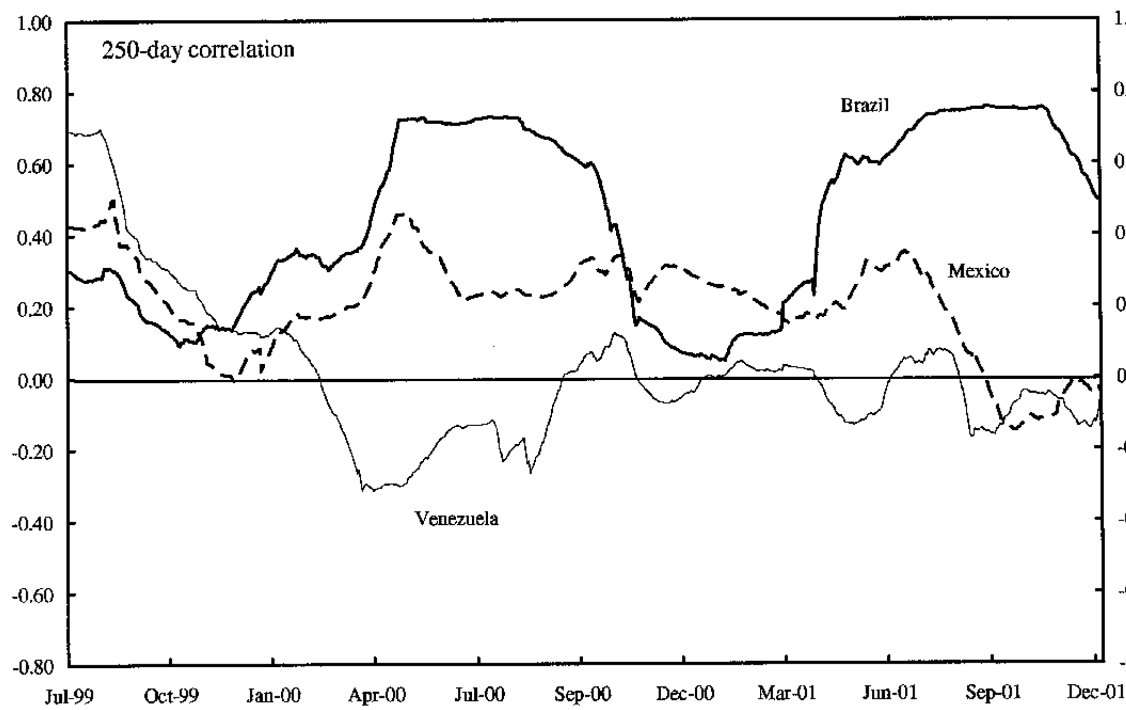
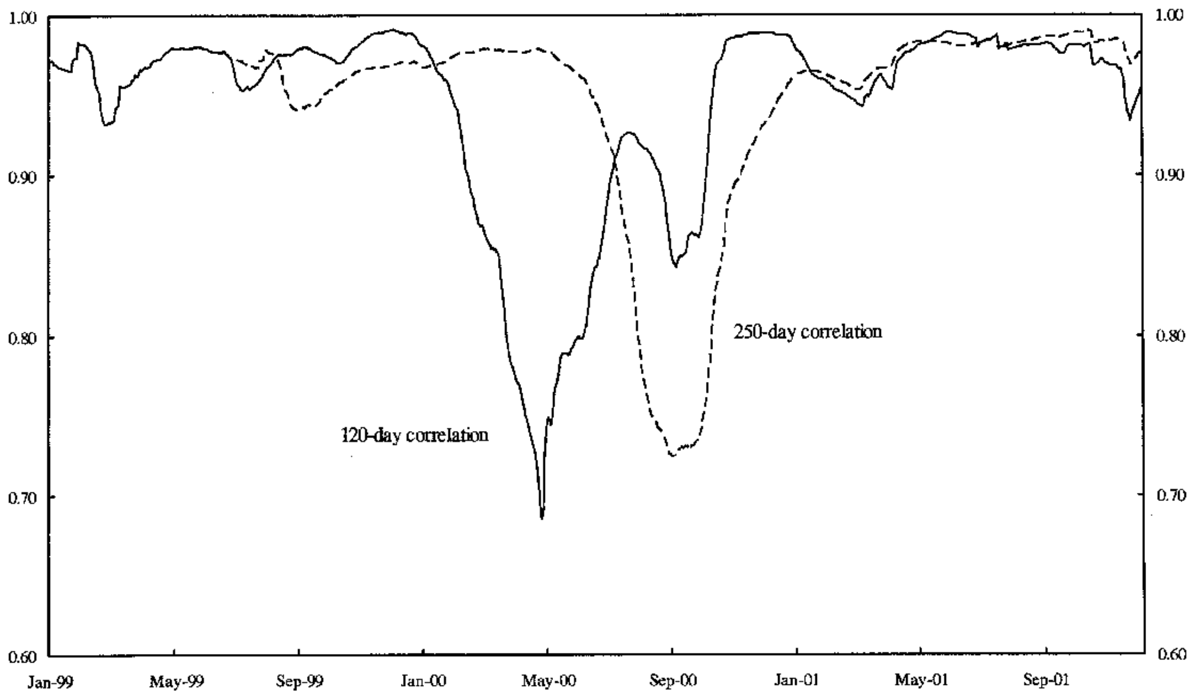
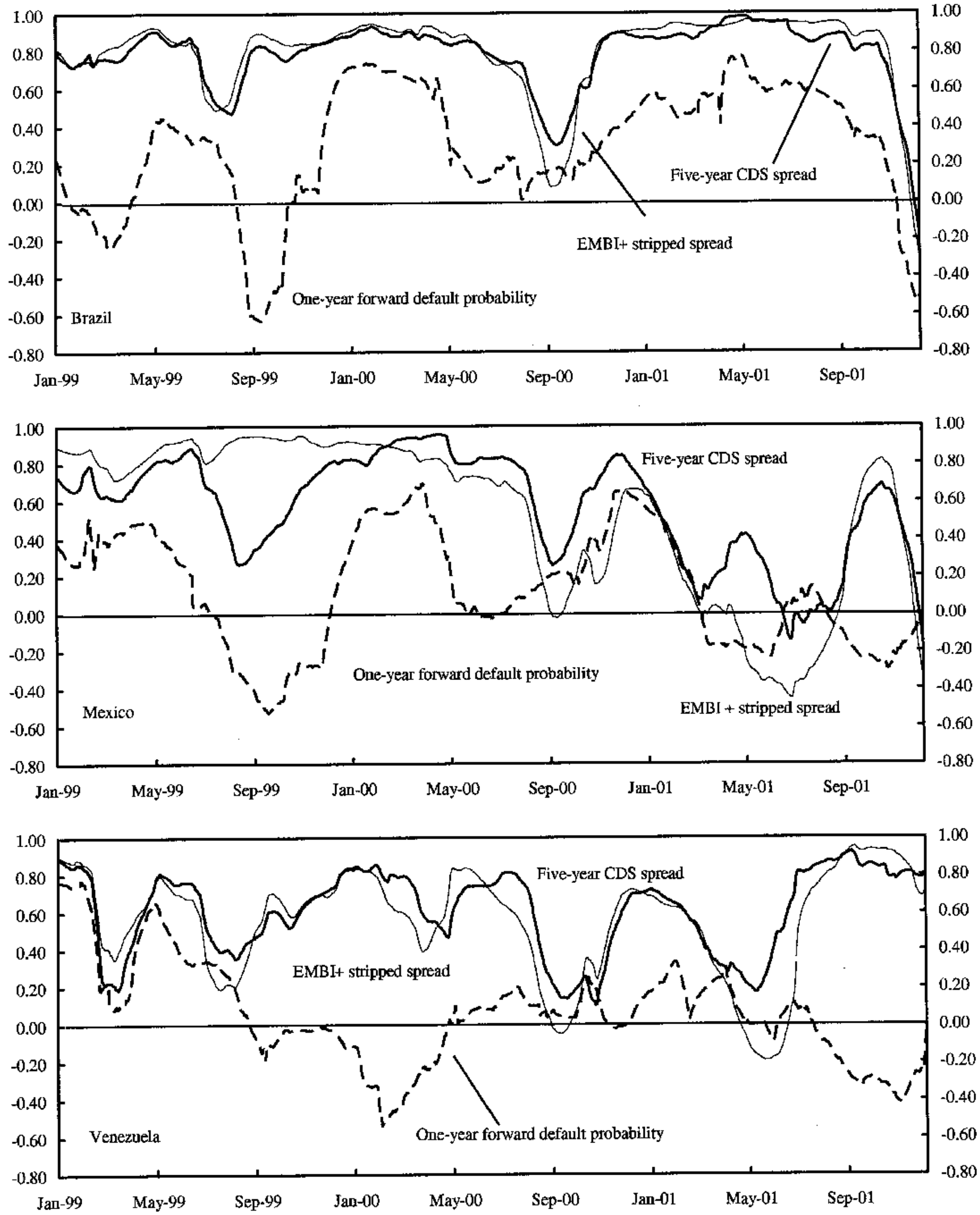


Figure 5. Argentina: Correlation Between EMBI+ Stripped Spread and Five-Year CDS Spread



Comparing spillover effects provides an alternative way to evaluate the information content in the bond and the CDS markets. Figure 6 shows the cross-country rolling correlations with Argentina for EMBI+ stripped spreads, five-year CDS spreads, and one-year default probabilities of Brazil, Mexico, and Venezuela. The five-year CDS spread correlation tracks the EMBI+ stripped spread correlation very closely. The only exception is Mexico in the second half of 1999, when the five-year CDS spread correlation was substantially lower than the EMBI+ stripped spread correlation. The one-year default probability correlation is, on average, lower than the both the CDS and EMBI+ spreads correlation. More importantly, in many instances, probability correlations turned negative in advance of CDS and EMBI+ spreads correlations. Thus, probability correlations may signal decoupling between countries faster than the other measures analyzed.

Figure 6. Cross-Country Correlations with Argentina: Spreads and Default Probability[1]



[1]120-day correlation

VI. Conclusions

Credit default swaps contain useful information about market views on the expected loss given default faced by a bondholder. However, in reduced-form pricing models, it is difficult to disentangle the contributions of the probability of the credit event and the recovery value in determining the expected loss given default.

This paper suggest an alternative way to think about recovery values by introducing the notion of maximum recovery rate, i.e. the maximum recovery rate consistent with a given credit default swap curve in any given date, and its implied term structure of hazard rates (or default probabilities). The recent sovereign default of Argentina in January 2002 was analyzed using the maximum recovery rate methodology. The results indicate that the correlation between the maximum recovery rate and default probabilities turn negative in advance of the credit event, and can be used for constructing early warning indicators of debt default.

In addition, the paper finds important differences between the information embedded in bond prices and CDS spreads that may be helpful to analyze default correlation at the sovereign level. Future work will study this issue in detail.

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