ANALYSIS OF CREDIT DEFAULT SWAPS IN TURKEY

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ABSTRACT

ANALYSIS OF CREDIT DEFAULT SWAPS IN TURKEY

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This thesis contributes to the literature mainly in two areas. Firstly,it is an investigation of applications of credit default swaps in Turkey, which are becoming increasingly important and growing rapidly in terms of number of applications in world financial markets. For this, we have studied balance sheets of firms and financial institutions and interviewed with Turkish commercial banks. We have also examined credit default swap contracts that are undertaken by Turkish banks. So, we have aimed to learn about applications of credit default swaps in our country. Then, we have examined the data of Turkish credit default swaps and Treasury bonds for the last 4-5 years and we have studied the correlations between these assets with each other and economic situation. In the second part, we have adapted some credit default swap studies for other emerging markets to Turkey. We wanted to investigate whether Turkish credit default swaps were overpriced or not. Finally, based on our findings, we have calculated default risk of Turkey in the following five years.

Keywords: *credit default swaps, credit risk, credit derivatives*

ÖZET

KREDİ TEMERRÜT TAKASLARI TÜRKİYE ANALİZİ

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Bu tezde temel olarak iki çalışma yapılmıştır. Öncelikle son yıllarda önemi ve kullanımı tüm dünyada giderek artan kredi temerrüt takaslarının Türkiye'deki kullanımı ve uygulamaları araştırılmıştır. Bunun için, İstanbul Menkul Kıymetler Borsasına üye firmaların dönem sonu bilânçoları incelenmiş; ayrıca Türkiye'de faaliyet gösteren özel sermayeli ticari bankalar nezdinde araştırma yapılmış, Türkiye'de yer verilen kredi temerrüt takas sözleşmeleri incelenmiştir. Böylece, kredi temerrüt takaslarına ülkemizde bugüne kadar hangi amaçlarla yer verildiği araştırılmıştır. Diğer yandan, Türk kredi temerrüt takaslarının ve Türk hazine bonolarının son 3–4 yıllık verileri incelenmiş, belirtilen kıymetlerin birbirleri ile ve ekonomik gelişmelerle olan bağlılaşımları incelenmiştir. Çalışmamızın ikinci kısmında, gelişmekte olan ülke piyasaları için yapılmış olan çalışmalar Türkiye'ye uyarlanmış, 03.10.2005 – 05.12.2005 dönemine ilişkin kredi temerrüt takası fiyatlarının teorik olarak olması gerekenden yüksek olup olmadığı belirlenmeye çalışılmıştır. Son olarak da bu aşamaya kadar elde edilmiş olan verilerin ışığında Türkiye'nin önümüzdeki beş yıl içerisinde borçlarını zamanında ödeyememesi olasılığı hesaplanmaya çalışılmıştır.

Anahtar Kelimeler: *Kredi temerrüt takasları, kredi riski, kredi türevleri*

To My Country and To People Who Love This Country

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INTRODUCTION

Credit derivatives, have been popular credit risk management tools for the last decade and usage of them is increasing sharply. Especially in emerging markets, credit default swaps are the most common credit derivatives. On the other hand, in our country credit default swaps are not used widely. It can be said that usage of credit derivatives in Turkey is almost negligible when compared to other countries. But when the increase in the usage of credit derivatives in the world is considered it is unavoidable that usage of credit derivatives will increase also in our country. During our studies, all the representatives of the commercial banks in Turkey, expressed that they were planning to use credit derivatives, for risk management purposes. This also supports our projection in the previous sentence.

To our knowledge, there is not an academic study on credit default swaps in Turkey. In our view credit default swaps (CDSs) will play an important role in the credit activities in the future, this study is the first on credit default swaps in Turkey.

Our thesis starts with a literature review of credit default swaps. We will first give basic definitions of credit default swaps. Then we will present the situation of credit default swaps in developed and emerging markets, current size of credit derivatives and credit default swaps market in the world, and the recent developments in the CDS market. We will then mention the studies stating advantages and disadvantages of credit default swaps. Then we will give different approaches to pricing of credit default swaps.

In chapter III we will give detailed information about credit risk from the perspective of probability. The main goal of this part is to explain credit risk, default probabilities, expected losses in case of default etc. This chapter forms technical background for our studies.

In chapter IV we will explain managing credit risk. However we will mainly discuss modern methods i.e. credit derivatives in this chapter. First, we will present what purposes credit derivatives are used for, and then we will discuss different types of credit derivatives such as total return swaps, credit spread options, credit linked notes, collateralized debt obligations etc. As we are mainly interested in credit default swaps, we discuss them in a separate chapter. The next chapter is about credit default swaps.

Chapters VI and VII are the main parts of the thesis. In our study we first tried to determine the current applications of credit default swaps in Turkey. Our first aim is to see the extent to which Turkish banks and financial institutions use credit default swaps. Then we want to evaluate whether we have enough data for credit default swaps in Turkey to improve our understanding of their potential.

We will then try to evaluate the pricing of Turkish credit default swaps. We want to find whether Turkish CDSs are overpriced or not; because it is most of the studies for other countries, especially emerging markets, state that credit default swaps are overpriced.

Finally with the previous studies at hand, we will try to find the term structure of default probabilities for Turkey. And, we will discuss whether current data and market conditions are sufficient to interpret our result.

At the final of our thesis there is a conclusion chapter that summarizes the thesis.

CHAPTER II

LITERATURE REVIEW

A Credit Default Swap is a mechanism for distributing the default risk of securities and loans, enabling lenders and investors to improve risk management and better achieve their financial goals. In this case, one party makes periodic basis points payments and another party makes payments for the principal if the "credit default" event occurs. The pricing of such a derivative, depends upon the credit quality of the reference credit, supply and demand for the reference credit, and prevailing credit spreads. The objective might be any of the following: to sell a specific risk, e.g. country risk in a project finance transaction, to free up credit lines for a specific customer, to pick up additional yield by assuming the credit risk, to improve portfolio diversification, to gain exposure to credits without buying the assets or to assume an off-balance-sheet synthetic position.

A credit-default swap contract can be illustrated as follows. The first party to the contract, the protection buyer, wishes to insure against the possibility of default on a bond issued by a particular company. The company that has issued the bond is called the reference entity. The bond itself is designated the reference obligation. The second party to the contract, the protection seller, is willing to bear the risk associated with default by the reference entity. In the event of a default by the reference entity, the protection seller agrees to buy the reference issue at its face value from the protection buyer. In return, the protection seller receives a periodic fee from the protection buyer. This fee, typically quoted in basis points per $100 notional amount of the reference obligation, is called the default swap premium.

Once there has been a default and the contract has been settled (exchange of the bond and the face value) the protection buyer discontinues the periodic payment. If a default does not occur over the life of the contract, then the contract expires at its maturity date.

As a specific example, suppose that on January 23, 2006, a protection buyer wishes to buy five years of protection against the default of the AAACO 7,75% bond maturing April 1, 2011. The buyer owns 10.000 of these bonds, each having a face amount of $1.000. Thus, the notional value of the buyer's position is $10.000.000. The buyer contracts to buy full protection for the face amount of the debt via a single-name credit-default swap with a 169 basis point premium. Thus, the buyer pays a premium of $A/360 \times 169$, or approximately 42,25 basis points per quarter for protection, where A denotes the actual number of days during a quarter. This translates into a quarterly payment of $A/360 \times \$10.000.000 \times 0{,}0169 = A/360 \times \$169.000$. If there is a default, then the buyer delivers the 10.000 AAACO bonds to the protection seller and receives a payment of $10.000.000. If the credit event occurs between default swap premium payments, then at final settlement, the protection buyer must also pay to the protection seller that part of the quarterly default swap premium that has accrued since the most recent default swap premium payment. Credit events that typically trigger a credit-default swap include bankruptcy, failure to pay, default, acceleration, repudiation, moratorium, or a restructuring.

In most of the CDS contracts, the parties may agree that any of a set of bonds or loans may be delivered in the case of a physical settlement. In any case, the deliverable obligations are usually specified in the contract. It is also possible, however, that a reference obligation may not be specified. In this case, any senior unsecured obligation of the reference entity may be delivered. Cash settlement, rather than physical settlement, may be specified in the contract. The cash settlement amount would either be the difference between the notional and market value of the reference issue (which could be ascertained by polling bond dealers), or a predetermined fraction of the notional amount. Note that, because the protection buyer generally has a choice of the bond or loan to deliver in the event of default, a credit-default swap could include a delivery option similar to that in Treasury note and bond futures contracts.

Since credit-default swaps are OTC contracts, the maturity is negotiable, and maturities from a few months to ten years or more are possible, although five years is the most common or liquid maturity in the market. In the notional amount of credit-default swaps ranges from a few million to more than a billion dollars, with the average being in the range of $25 to $50 million (J.P. Morgan (2000)). A wide range of institutions participate in the credit-derivatives market. Banks, security houses, and hedge funds dominate the protection-buyers market, with banks representing about 50 percent of the demand. On the protection-sellers side, banks and insurance companies predominate (British Bankers' Association (2002)).

Banks desiring to reduce or eliminate their exposure to a particular loan or basket of loans can buy a CDS without the borrower's knowledge or consent (which may be required when the loans are sold outright). Manufacturing companies that depend upon a limited number of customers for revenue can buy a CDS on their customers' payment obligations. Investors who need to protect themselves against default but cannot or do not want to sell the at-risk security for accounting, tax or regulatory reasons, can buy a Credit Default Swap. Investors can pick up additional yield without buying an asset, holding it on their balance sheet and funding it. Building on the basic swap structure, investors can swap the default risk of one credit with that of another credit. This can help companies diversify their portfolios while making it possible to avoid the transaction costs associated with buying and selling many individual securities or loans.

Credit events in such transactions are pre-defined in the agreement, which could include a payment default, bankruptcy or debt rescheduling. The credit event must be material and objectively measurable, this has been one of the major issues addressed by the International Swaps and Derivatives Association (ISDA). The reference credit can be any loan or security, a basket of loans or securities, regardless of the currency, and the tenure of the swap can match or be shorter than the tenure of the reference credit.

Credit default swaps will be discussed in more detail and from a more technical point of view in the following chapters. In this chapter we will now discuss the studies on credit default swaps. But first we will mention the usage of credit default swaps in developed and emerging countries. As our subject of discussion is credit default swaps in Turkey, CDS markets in emerging markets are more important for our study.

In the developed countries, underlying assets of majority of credit default spreads are corporate bonds. For example, in USA a total of 393 transactions occurred between January 1998 and February 2000, and just 70 of those were sovereign (Cossin et al, 2000). On the other hand in emerging markets like Argentina, Turkey etc. underlying assets are government bonds. To reflect this fact, it may be useful to tell that between years 2000 and 2003, 90% sovereign credit default swap quotes were quotes in emerging markets (Packer (2003)). In the same period, proportion of number of quotes in Turkey to total number of quotes was 3,9%. With Basel II, we foresee that rating system will also develop in emerging countries. After that, credit default swaps that are underlied by corporate bonds will be quoted in emerging countries.

A high proportion of the studies on credit default swaps, or generally credit derivatives emphasize advantages of credit default swaps. First of all, credit derivatives are used to transfer and value credit risk correctly (Aggrawal (2000)). Credit default swaps, may be used for risk management while credit default swaps do not need an initial funding. In addition, CDS transaction can be entered although a cash bond of a reference entity and of a particular maturity is not available, and finally by buying credit protection by CDS, one can easily create a short position in a reference credit (Jacob et al (2004)).

The CDS market is still a growing market. The volume of CDS market has grown significantly in recent years. In the future, this growth is waited to continue and CDS contracts will be standardized also. With those developments, the benefits of credit default swaps will be generated (Bomfim (2001)). Another view is that credit default swaps provide the best information on credit risk (Aunon-Nerin (2002)).

While credit default swaps have many advantages, according to some studies they have also some disadvantages. When, financial transparency is low, and there exists informational asymmetries, credit default swaps are priced incorrectly and risk is not managed efficiently (Merritt (2003)). As mentioned above, rating system is not fully efficient in emerging markets, e.g. Turkey. This is another reason that causes credit risk's being managed incorrectly.

Implying default rates using credit default spread data in especially emerging markets is another important subject of study. Credit default swaps are used to get information about market views on the amount of expected losses by bondholders when a default occurs. The correlation between maximum recovery rates and default probabilities goes below zero before credit events and this can be used to indicate defaults (Chan Lau (2003)). In another study, it is concluded that examining credit default swap data gives healthy measures of default risk in Japan (Ito (2003)).

As credit default swaps market is a newly growing market and not standardized totally, the subject of pricing credit default swaps is another important point of study in both academic and business researches. CDS spreads are affected from some variables. The most important of those is rating. It can simply be said that ratings are negatively correlated to CDS spreads (Micu (2004)). Other factors that influence CDS spreads are economic conjuncture, bond rates, country premium etc.

There are various methods in pricing credit default swaps. Some researchers use default probabilities to price credit default swaps (Garcia (2001)), while other studies use risk-neutral pricing theory to price credit default swaps (Skora (1998)). Some complex simulation methods like first-passage-time default probability under jump diffusion are also used by some academicians (Joro, 2001). Another simulation method concludes that, risk-free rate used by market participants is about 10 basis points less than CDS rates on average (Hull (2002)).

Another important study, on pricing of credit default swaps concludes that CDS prices and bond prices must be equal in the long run although they show great discrepancies in the short term (Zhu (2004)).

As we will study credit default swaps in Turkey, it is important to know whether credit default swaps are priced correctly in practice. In a research by Longstaff et al (2003), credit default swap premia and corporate bond yields of a sample of firms are compared and it is concluded that credit protection is priced expensively. In his study, Singh (2003) discusses that not linking recovery value to cheapest to deliver bonds may lead to overpricing CDSs.

In a study by Ranciere (2001), synthetic default swaps are formed and spreads of those are compared with real credit default swap data of Argentina. At the end of this study it is seen that credit default swaps are priced expensively in Argentina. It is concluded that, the reason of overpricing of credit default swaps in Argentina may be explained by lack of liquidity in the market, the value of embedded delivery option and repo market risks. The methodology of this study will be used for Turkey by us in the following chapters.

In our study we will first study on the data of credit default swaps and government bonds of Turkey for the last 3-4 years and comment on the correlations between them. We will also analyze the CDS data with respect to economic conjuncture of Turkey.

In the next step we will calculate synthetic default spread rates and compare this with real credit default swap data. By this, we will be analyzing whether Turkish credit default swaps are priced correctly.

Finally, with the previous studies at hand we will calculate default probabilities of Turkey and reach term structure of default probabilities of Turkey.

CHAPTER III

CREDIT RISK

Credit risk is the possibility that a borrower will not pay a debt on time. The probability that the borrower will not service is reflected in the borrower's credit rating, which defines the premium over the riskless borrowing rate it pays for funds and ultimately the market price of its debt. Credit risk has two variables which are market risk and firm-specific risk. Credit derivatives allow users to isolate, price and trade firm specific credit risk by unbundling a debt instrument or a basket of instruments into its components and transferring each risk to those best suited or most interested in managing it. There are various traditional mechanisms to reduce credit risk including refusal to make a loan, insurance products, guarantees and letters of credit, but these mechanisms are less effective during periods of economic downturn when risks that normally offset each other simultaneously default and financial institutions suffer substantial loan losses (Hull J. (2004)).

Potential defaults by borrowers, counterparties in derivatives transactions, and bond issuers give rise to significant credit risk for banks and other financial institutions. As a result, most of the financial institutions devote considerable amounts of resources to the measurement and management of credit risk. Regulators require banks to keep capital to reflect the credit risks they are bearing.

In this chapter we will focus on the quantification of credit risk. First, a number of different approaches to estimate the probability that a company will default will be discussed. We will explain the main difference between the risk-neutral and real-world probabilities of default. Then we will discuss how a financial institution can estimate its loss if a default by a company occurs. The probability of default and the loss given default jointly determine the financial institution's expected loss. The last section includes credit ratings migration and default correlation, and shows how the value-at-risk can be used for credit risk and market risk.

III. 1. DEFAULT PROBABILITY

Rating agencies like Moody's and S&P provide ratings that describe the creditworthiness of corporate bonds. Acording to Moody's system, the best rating is Aaa. Bonds with rating of Aaa are considered to have almost no probability of default. The second best rating is Aa. Following that rating come A, Baa, Ba, B, and Caa. Only bonds with ratings of Baa or above are considered to be worth of investment. The S&P ratings corresponding to Moody's Aaa, Aa, A, Baa, Ba, B and Caa are AAA, AA, A, BBB, BB, B, and CCC, respectively. To create finer rating measures, Moody's divides the Aa rating category into Aa1, Aa2, and Aa3; it divides A into A1, A2, and A3; and so on. Similarly S&P divides its AA rating category into AA+, AA, and AA-; it divides it's A rating category into A+, A, A-; and so on. (Only the Aaa category for Moody's and the AAA category for S&P are not subdivided.)

Algorithms for taking credit risk into account when pricing corporate bonds are developed. Market data of actively traded bonds is collected and generic zero-coupon yield curve for each credit rating is plotted. These curves are then used to value other bonds.

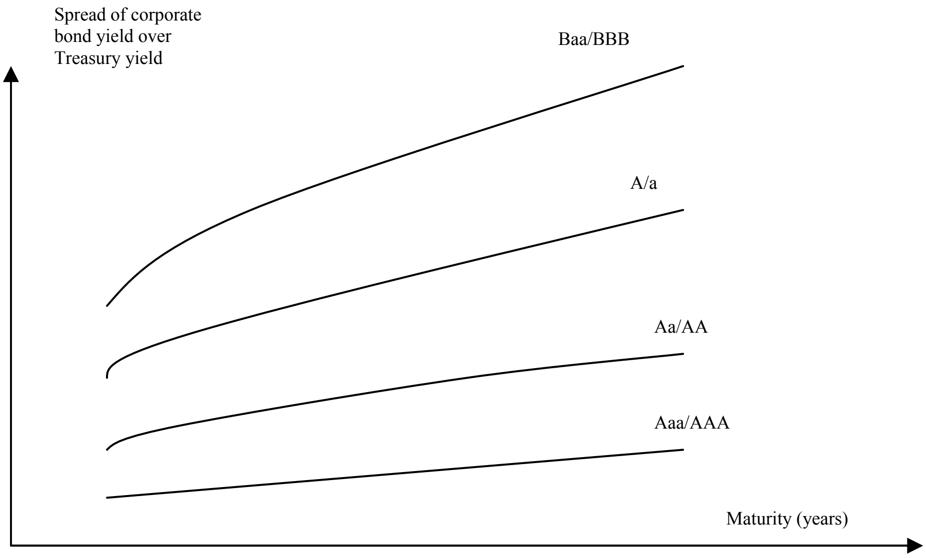


Figure 1: Spread over Treasury zero curve for corporate bond yields (Hull (2004))

In Figure 1 we can see a typical pattern for the spread over the Treasury zero curve for the yields on zero-coupon bonds that have investment grade, different maturities and different credit ratings.

The spread and the rating are inversely proportional. Spread is also proportional to maturity. It is also another important point that for low credit ratings, spread increases faster with maturity.

Expected Default Losses

To estimate default probabilities from bond prices we must first calculate the expected default losses on bonds that have different maturities. For that, we must compare the price of a corporate bond with the price of a risk-free bond. The two bonds must have the same maturity and pay the same coupon. It is generally assumed that the present value of the cost of default is equal to the difference between price of the corporate bond and the risk-free bond.

We can calculate the price of the risk free bond using the risk free zero curve. Generally for risk free zero curves, Treasury curves are used. On the other hand, it must be noted that sometimes Treasury bonds have unnatural low yields. Because of this some analysts use LIBOR for risk free zero curve.

To illustrate the material explained up to now let's think that risk free rate is 4% and, a corporation issues zero coupon bonds with maturities between one and five years. Risk free rates and yields of bonds for each maturity are given in Table 1.

The price of a risk free bond with a principal of 100 can be calculated by 100[e^(-0,04)], which equals to 96,07835. And the value of the corporate bond with the same maturity date is 100[e^(-0,0435)] that equals to 95,74261. As we said before, expected loss from default equals to the difference between these two values. So, expected loss is 96,07835 – 95,74261=0,3357.

Now let's think of the bond with maturity of two years. The value of a two-year risk-free bond with a principal of 100 is 100[e^(-0,04x2)] = 92,3105. The value of a similar corporate bond is 100[e^(-0,044x2)] = 91,57485. The present value of the expected loss from defaults on the two-year corporate bond is 92,3105 – 91,57485 = 0,7357. Expected losses for bonds with different maturities are given in Table 1.

Table 1: Expected default losses on bonds issued by a corporation.

Maturity (years)	Risk-free zero rate (%)	Corporate bond Zero rate (%)	Expected default loss (% of no-default value)
1	4,00	4,35	0,3357
2	4,00	4,40	0,7357
3	4,00	4,60	1,5824
4	4,00	4,75	2,5188
5	4,00	4,85	3,4071

Default Probability (No Recovery)

Let's define:

y(T) : Yield on a zero-coupon bond of a corporation with T years of maturity.

y'(T) : Yield on a risk-free zero-coupon bond with T years of maturity.

P(T) : Probability that the corporation will default between time zero and T

We know that the price of a T-year risk-free bond with zero coupon with a principal of 100 is 100[e^(-y'(T)T)]. And that of a corporate bond with similar properties is 100[e(-y(T)T)]. So, the expected loss from default is therefore $100[e^{-y'(T)T} - e^{-y(T)T}]$ as stated in the previous section.

Assuming that there is no recovery if the corporate defaults, the probability that the corporate bond will be worth zero at maturity is P(T). And, the probability that the value of the bond will be 100 is 1 – P(T). The expected value of the bond is then,

$\{P(T)x0 + [1-P(T)]\ x100\}\ e^{-y'(T)T} = 100[1-P(T)]\ e^{-y'(T)T}$

As we know from the previous section the value of the bond is $100\ e^{-y(T)T}$. So equating the two terms gives $100\ e^{-y(T)T} = 100[1-P(T)]\ e^{-y'(T)T}$.

Getting P(T) from the equation above we have :

$$P(T) = 1 - e^{-[y(T)-y'(T)]T} \quad (1)$$

If we look back to example in Table 1, the cumulative probability of default and probability of default in each year are given in Table 2. The cumulative probability of default is the expected percentage loss from default that is calculated in Table 1. And the probability of default by time intervals is found by calculating the differences between consecutive cumulative probabilities.

Table 2: Probabilities of default for the example in Table 1.

Year	**Cumulative default probability (%)**	**Default probability in year (%)**
1	0,3494	0,3493
2	0,7969	0,4476
3	1,7842	0,9873
4	2,9559	1,1717
5	4,1616	1,2057

Hazard Rates

At this stage it is appropriate to mention that there are two ways of quantifying probabilities of default. The first is in terms of hazard rates and the second is in terms of the default probability density.

The hazard rate, h(t) at time t is defined so that h(t)δ(t) is the probability of default between time t and t + δt and no default occurs between time zero and t. And, the default probability density, q(t), is defined so that q(t)δt is the unconditional probability of default between times t and t + δt. For default probability density there is not a condition.

Both of the functions given above can be used to describe the default probabilities equally. The relationship between h(t) and q(t) is defined as:

$$q(t) = h(t)e^{\wedge}\left(\int_{0}^{t} h(\tau)\tau\right)$$

The probabilities of default listed for each year in Table 2 are the unconditional probabilities of default as seen at time zero. Let's consider year 5. Table 2 lists the probability of default as 1,2057%. Hazard rate is the probability of default in year 5 conditional on no default up to year 4. The probability of no default prior to year 4 is 1 – 0,029559 = 0,970441%. The hazard rate for year 4 is therefore 0,012057/0,970441 = 1,2424%.

Recovery Rates

Up to now we have assumed that no recovery occurs in the event of a default. However, it can be said that it is not a realistic assumption. When a company goes bankrupt, the assets of the company are sold by the liquidator and the income is used to meet the claims of the lenders. Some claims typically have priorities over others and are met more fully.

Recovery rate is defined as the proportion of the amount received to the amount claimed if a default occurs. We can assume that claimed amount of the bond is the value of the bond with no default for simplification. Let's say expected rate of recovery is R. Then if a default occurs, the bondholder receives a proportion R of the bond's no-default value. From previous sections we know that no-default value is $100\ e^{-y'(T)T}$ and the probability of a default is P(T).

The value of the bond can also be written as: $[1 - P(T)]100\ e^{-y'(T)T} + P(T)100R\ e^{-y'(T)T}$
then, $100\ e^{-y(T)T} = [1 - P(T)]100\ e^{-y'(T)T} + P(T)100R\ e^{-y'(T)T}$

From this we can derive P(T) as

$$P(T) = \frac{1 - e^{-[y(T)-y'(T)]T}}{1-R} \qquad (2)$$

Here one interesting result is that, recovery rate and default probabilty are positively correlated. This is because, since organisations aim to price and provide for expected loss, this result illustrates the dramatic impact that a first order improvement in recovery rate estimation can have on the performance of an organisation, by the resultant improvements in risk estimation and pricing. The economic intuition to explain a positive dependence between recovery rate and default probability may include: In poor economic periods, firms default more often, and their defaulted assets have a lower value to the potential buyers of those defaulted assets. During an economic downturn the potential buyers of defaulted assets, 1) may have fewer profitable opportunities with which to redeploy defaulted assets, 2) may themselves have less cash with which to buy the defaulted assets, and 3) may see less need in the market to bid-up the price of defaulted assets.

More Realistic Assumptions

Equation (2) is often used to provide a quick estimate of the probability of default. In the previous section we have assumed that the amount claimed in the event of a default is equal to the no default value of the bond. We can say that this assumption is realistic but does not reflect the real life conditions in most countries. If we assume that the claim when default occurs, equals to the sum of bond's face value and accrued interest. Equation (2) also assumes bonds are zero-coupon bonds. But in reality default probabilities must be calculated from coupon bearing bond prices.

Let's chose a set of N coupon-bearing bonds. Assume that defaults can happen only on any of the bond maturity dates. The maturity of the i^{th} bond is ti with $t1<t2<\ldots<tN$.

Define:

Bj : Current price of the j^{th} bond

Gj : Current price of risk free bond with same cash flows with the j^{th} bond

Fj(t) : Forward price of the j^{th} bond for a forward contract maturing at time t with the assumption that the bond won't default.

$\nu(t)$: Present value of 1 unit received at time t

Cj(t) : Claim made by holders of the j^{th} bond if there is a default at time t

Rj(t) : Recovery rate for holders of the j^{th} bond in the event of a default at time t

α j(t) : Present value of the loss from a default on the j^{th} bond at time ti

pi : The probability of default at time ti

The price at time t of the no-default value of the j^{th} bond is $F_j(t)$. If there is a default at time t, the bondholder makes a recovery at rate $R_j(t)$ on a claim of $C_j(t)$. So we can say that present value of the loss from a default on the j^{th} bond at time ti is:

$$\alpha_{i,j} = v(t_i)[F_j(t_i) - R_j(t_i)C_j(t_i)]$$

The probability that the loss $\alpha_{i,j}$ will be incurred is p_i. So the total present value of the losses on the j^{th} bond is

$$G_j - B_j = \sum_{i=1}^{j} p_i \alpha_{ij} \qquad (3)$$

Using the equation above we can first derive p_1 which is equal to $(G_1 - B_1)/\alpha_{11}$. The other probabilities can be calculated by

$$p_j = \frac{G_j - B_j - \sum_{i=1}^{j-1} p_i \alpha_{ij}}{\alpha_{ij}} \qquad (4)$$

It must be noted that N bonds we use in the analysis may be issued either by the reference entity or by another company that have the same risk of default. So the pi should be the same for all bonds. On the other hand, in theory the recovery rates can vary according to the bond and the default time. For simplicity we can assume that expected recovery rate for all the bonds issued by a company is the same. Let's denote this recovery rate by R'. So the equation for α_{ij} simplifies to

$$\alpha_{ij} = v(t_i)[F_j(t_i) - R'C_j(t_i)] \qquad (5)$$

The Case When Default Happens at Any Time

In the previous sections we have assumed that defaults can take only on bond maturity dates. This assumption can be improved by allowing defaults to occur at any time. As we defined earlier, q(t) is the default probability density.

First we can assume that q(t) is constant and equal to qi for ti-1< t < ti.

$$\beta i,j = \int_{ti-1}^{ti} v(t)[Fj(t) - R'Cj(t)]dt \qquad (6)$$

a similar analysis to that used in deriving equation (3) gives

$$qj = \frac{Gj - Bj - \sum_{i=1}^{j-1} qi\beta ij}{\beta jj} \qquad (7)$$

III. 2. HISTORICAL DATA

Default probabilities can also be estimated by means of histotrical data. Table 3 is an example data produced by rating agencies. The data gives default rates of companies with time that started with a certain rating. Looking at the year we can find the probability of a bond defaulting in a certain year.

Table 3: Historical cumulative default rates.

	Term (years)							
Rating	**1**	**2**	**3**	**4**	**5**	**7**	**10**	**15**
AAA	0,00	0,00	0,04	0,07	0,12	0,32	0,67	0,67
AA	0,01	0,04	0,10	0,18	0,29	0,62	0,96	1,39
A	0,04	0,12	0,21	0,36	0,57	1,01	1,86	2,59
BBB	0,24	0,55	0,89	1,55	2,23	3,60	5,20	6,85
BB	1,08	3,48	6,65	9,71	12,57	18,09	23,86	27,09
B	5,94	13,49	20,12	25,36	29,58	36,34	43,41	48,81
CCC	25,26	34,79	42,16	48,18	54,65	58,64	62,58	66,12

As we have discussed, while discussing Figure 1, the probability default in a year increases with time for investment rate bonds. And for the other bonds i.e. for bonds with low rating the reverse is true. This statement can also be derived from the table above.

III. 3. BOND PRICES and HISTORICAL DEFAULT EXPERIENCE

The default probabilities in Table 3 are significantly less than we would expect from an analysis of bond prices. Let's consider, a five-year A-rated zero-coupon bond. We suppose that the yield on this bond is 50 basis points above the risk-free rate. Assuming a zero recovery rate, equation (1) gives an estimate for the probability of default during the five years of $(1 - e^{-0,004x5}) = 0,0198$ or 1,98%. By contrast, the historical probability of default over five years for an A-rated bond is from Table 3 is only 0,57%.

There are two main assumptions:

- The difference between yield of A rated bonds and risk free rate is 50 bps
- Recovery rate is equal to zero

But in real life the difference is more than 50 bps and recovery value is not equal to zero. The probability of default increases proportionally with the yield of the bond and/or recovery rate.

As we see using bond prices we reach higher probabilities of default than historically observed. This may be because of investors' raising expected returns they require on corporate bonds to compensate for their low liquidity. Or another reason may be that bond traders take the possibility of economic downturn, into consideration.

Now we will discuss risk free versus real world calculations. Let's think of again the example above. With the two assumptions we made above, we have calculated the probability of default during the five-year life of the bond as 1,98% from the bond price. This is almost four times the estimate of 0,57% from historical data.

We can say that 1,98% is an estimate of the probability of default in a risk-neutral world, whereas 0,57% is an estimate of the probability of default in the real world. Let's first note that the price of the corporate bond is 1,98% less than that of a risk-free bond.

Now we may ask whether to use real world or risk-neutral default probabilities in the analysis of credit risk. The answer may change according to the purpose of the analysis. If we value credit derivatives or estimate the effect of default risk on pricing of instruments, we must use risk-neutral probabilities. Because we tend to implicitly or explicitly use risk-neutral valuation in our analysis. On the other hand if we want to calculate potential future losses because of defaults, using real-world default probabilities is better.

III.4. CALCULATING DEFAULT PROBABILITIES USING EQUITY PRICES

In previous sections we have estimated default probability of a company with the help of credit rating of the company. But it can be said that credit ratings are revised rarely. Because of this some analysts support the idea of calculating default probabilities using equity prices.

In 1974, Merton proposed a model where a company's equity is an option on the assets of the company. For simplification we assume that a firm has one zero-coupon bond outstanding and that the bond matures at time T. Define:

V0 : Value of the company's assets today

VT : Value of the company's assets at time T

E0 : Value of the company's equity today

ET : Value of the company's equity at time T

D : Amount of debt interest and principal due to be repaid at time T

σV : Volatility of assets

σE : Volatility of equity

If VT < D, we can say that the company will default at time T. So the value of the equity is zero. If the reverse is true, the company should make the debt repayment at time T and the value of the equity at this time is VT – D. So according to Merton's model, the value of the firm's equity at time T as ET is equal to max(VT – D, 0).

The equity is a call option on the value of the assets with a strike price equal to the repayment required on the debt. According to the Black-Scholes formula the value of the equity today as:

$$E0 = V0N(d1) – D\, e^{-rT}N(d2) \qquad (8)$$

where

$$d1 = \frac{\ln V0 / D + (r + \sigma^2 V /2)T}{\sigma V\sqrt{T}}$$

and

$$d2 = d1 - \sigma V\sqrt{T}$$

The value of the debt today is (V0 – E0) and the risk-neutral probability that the company will default is N(-d2). For the calculation we need V0 and σV. These values can not be observed directly. But, we can observe E0 if the company is publicly traded. We can also estimate σE. From Ito's lemma,

$$\sigma EE0 = \frac{\partial E}{\partial V} (\sigma VV0)$$

$$\sigma EE0 = N(d1)\, \sigma VV0 \qquad (9)$$

This provides another equation that must be satisfied by σV and V0. Equations (8) and (9) provide a pair of simultaneous equations that can be solved for σV and V0.

Until now we have assumed that the company's debt is repayable at one time. In real life, debt repayments are done at different times. This makes the model more complicated. But in principle it is still possible to use an option pricing approach to obtain estimates of σV and V0. The default probability of the company at different times in the future can then be estimated.

There is a significant difference between default probabilities produced by merton's model and actual data. But Merton's model is also used in real life estimations. Some companies apply, a transformation to the probabilities from Merton's model to produce default probability estimates. Moody's risk management service uses the output from Merton's model in conjunction with other financial variables to get its default probability estimates.

In our view, it is early for Turkey to estimate default probabilities using equity prices. First of all we think trade volume is not high enough to allow prices occur free from speculations. It is the subject of another study but from past ecperience and observations we know that, there is not a correlation between default and equity price of a company in Turkish equity market.

III. 5. LOSS GIVEN DEFAULT

In the previous sections we have discussed the probability of default of a company in the future. Now we will discuss the calculation of expected loss given that the company defaults. This is known as the loss given default. Multiplying loss given default with the proability of default we will get the expeted loss.

The loss given default on a loan made by a financial institution is usually assumed to be, V- R(L+A) where

V : is the no default value of the loan.

L : outstanding principal on the loan,

A : accrued interest,

R : the expected recovery rate,

For derivatives loss given default is more complicated. This is because the claim that will be made in the event of default is less certain than it is for a loan or a bond. We can distinguish three types of derivatives:

1. Those that are always a liability
2. Those that are always an asset
3. Those that can be either a liability or an asset

Derivatives that are always a liability have no category risk. If the counterparty goes bankrupt, there will be no loss. Let's say for example a company has written an option. This derivative's position is a liability for the whole life of the option. If the counterparty goes bankrupt, the option is one of the counterparty's assets. The option may be retained, closed out or sold to a third party and option writer doesn't lose anything.

Derivatives in the second category always have credit risk. If the counterparty goes bankrupt, a loss is likely to be experienced. Let's consider a company that has bought an option. This is an asset. If the counterparty goes bankrupt, the option holder makes a claim and may face a loss.

Derivatives, in the third category may or may not have credit risk. Consider a company which enters an interest rate swap. It has a value equal to, or very close to, zero. As time passes interest rates change and the value of the swap may become positive or negative. If the counterparty defaults when the value of the swap is positive, a claim will be made against the assets of the counterparty and a loss is likely to be experienced. If the counterparty defaults when the value of the swap is negative, no loss is made. The swap will be retained, closed out or sold to a third party.

III. 6. DEFAULT CORRELATIONS

In some cases there may be a correlation between default probabilities of two companies. That may be because two companies may be in the same industry or may be in the same region, or they may belong to the same group and so events may effect them in similar ways.

Now let's think of two companies A and B. The measure of correlation is

$$\beta AB(T)=[PAB(T)-QA(T)QB(T)] / [\ \sqrt{\{QA(T)-QA(T)^2\}\{QB(T)-QB(T)^2\}}]$$

PAB(T) : joint probability of A and B defaulting between time zero and time T

QA(T) : cumulative probability that company A will default by time T

QB(T) : cumulative probability that company B will default by time T

Actually the term $\beta AB(T)$ is nothing else than statistical definition of correlation. It depends on T, the length of the time period considered and it is generally directly proportional to T.

Another correlation measure that is sometimes used is obtained from the probability distribution. Let tA and tB be the times to default of companies. tA and tB are not normally distributed. So in order to normalize tA and tB we use $uA(tA) = N^{-1}[QA(tA)]$ and $uB(tB) = N^{-1}[QB(tB)]$. Here N represents the normal distribution. And statistically, the correlation measure is defined as $\rho AB = corr[uA(tA), uB(tB)]$.

It is assumed that the variables uA(tA) and uB(tB) have a bivariate normal distribution. The joint probability distribution of the times to default can be described by the cumulative probability distribution QA(tA) of tA, the cumulative probability distribution QB(tB) of tB, and ρAB. The assumption is referred to as using a Gaussian copula.

Let $M(a,b;\rho)$ be the probability in a standardized bivariate normal distribution that the first variable is less than a and the second variable is less than b and the coefficient of correlation between the variables is ρ. And ρAB is correlation of default between A and B in the Gaussian copula model. Suppose also that uA(t) and uB(t) are the transformed times to default for companies A and B in the Gaussian copula model. So we can say, $PAB(T) = M(uA(t), uB(t); \rho AB)$

We can derive $\beta AB(T)$ from here and write,

$$\beta AB(T) = \frac{M(uA(T), uB(T); \rho AB) - QA(T)QB(T)}{\sqrt{[QA(T) - QA(T)^2][QB(T) - QB(T)^2]}} \quad (10)$$

The Gaussian copula approach can be extended to a multi-company case. Suppose there are N companies and ti gives the time company i defaults. Now, Qi(ti) is the cumulative probability distribution of ti and $ui(ti) = N^{-1}[Qi(ti)]$ for $1 \leq i \leq N$. ui(ti) is assumed to be multivariate normal. However there is no need to mention about many company model in detail.

III. 7. CREDIT VALUE AT RISK (CREDIT VAR)

The amount of credit loss that won't be exceeded with a certain probability is credit value at risk. The time taken into consideration is generally longer for credit VAR than for the market risk VaR. In general a time horizon of ten days is considered while measuring market value at risk. On the other hand this time horizon for credit value at risk is one year.

A credit loss may be experienced when the counterparty defaults. However suppose that rating of counterparty decreases. In that case probably all the contracts will be revalued and a credit loss will be experienced.

In calculating credit value at risk, one may consider either the first type of credit loss or the second. We will mention both types of calculating credit VAR. The two types of losses are equal in the long run but it is not the case in the short run. As mentioned before we must note that while calculating credit value at risk we must use historical data not bond prices. The approach that considers credit losses arises from company defaults is known as credit risk plus while the second is known as credit metrics.

Credit Risk Plus

The credit risk plus approach is improved by Credit Suisse Financial in 1997. It is a well applied methodology especially in insurance sector.

Assume that an institution has N counterparties. Default probabilities of counterparties in time T is p. Expected number of defaults for the whole portfolio is Np. Let's denote it with μ. Assume defaults are independent and p is small. The probability of n defaults have a Poisson distribution and we can define it as:

$$\frac{e^{(-\mu)} * \mu^n}{n!}$$

In order to get probability distribution of the sum of default losses from counterparties we can combine the distribution above with a probability distribution with a probability distribution for the losses experienced on a single counterparty default. To estimate the probability distribution for losses at the end of the default of a single counterparty, we can look at the current probability distribution of our exposure to counterparties and adjust this according to historical recovery rates.

In real life the counterparties of a bank or financial institution may be in several categories. So the algorithm must be applied for each category independently and then the result must be combined.

Default rates show difference from year to year. Due to data by Moody's, default rate per year for all bonds between 1970 and 1999, range from 0,09% in 1979 to 3,52% in 1990. To account for this, we can assume a probability distribution for the overall default rate based on historical data. Then the probability of default for each category can be assumed to be linearly dependent on this overall default rate.

If we make some assumptions, we can calculate the total loss probability distribution. For that it is appropriate to use Monte Carlo simulation. The procedure is given below:

- Get the historical data of default.
- Calculate default of probability of each category.
- Sample the number of defaults for each category.
- Sample the amount of loss for each default.
- Calculate amount of loss in total.
- Repeat previous steps many times.

If we assume a probability distribution for default rates it has the effect of making the probability distribution of total default losses positively skewed. This situation is given in Figure 2 below.

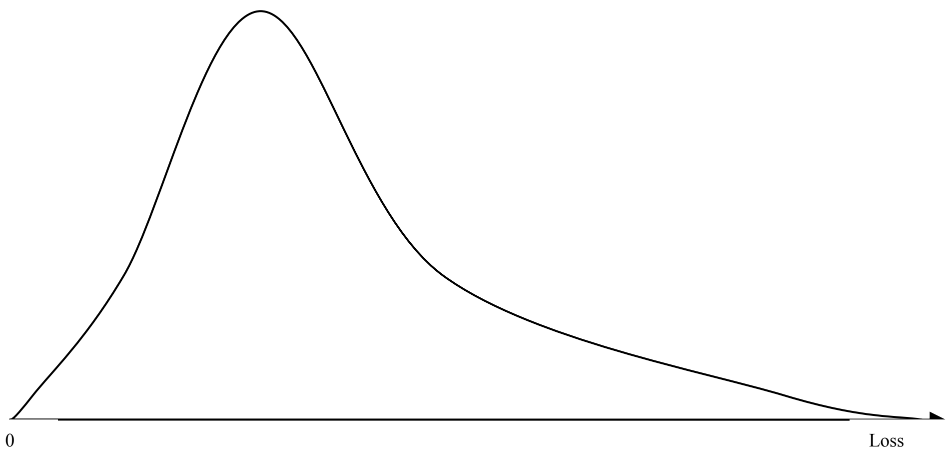


Figure 2: Probability distribution of default losses

Credit Metrics

The second methodology that accounts for ratings changes is named as credit metrics and a methodology to calculate the credit losses from changes in credit rating is developed by J.P.Morgans. This methodology is based on a simulation. It involves estimating probability distribution of credit losses by simulating changes in credit ratings of counterparties. Let's think that we want to find the probability distribution function of credit loss in a period of one year. On each simulation, we sample to determine the credit rating changes of all counterparties throughout the year. The changes in the relevant market variables are also sampled. According to credit rating changes, outstanding contracts are revalued. And lastly the amount of credit losses is calculated.

Credit metrics approach is more complicated than credit risk plus approach. But credit metrics approach has an advantage that, precise terms of outstanding contracts can be incorporated.

CHAPTER IV

MANAGING CREDIT RISK: CREDIT DERIVATIVES

IV. 1.Traditional Ways

Traditionally credit risk can be managed by,

1. Loan underwriting standard,
2. Diversification of the credit risk across different borrowers,

   - Their ability to reduce credit risk is limited by a lack of diversification opportunities.
3. Securitization,

   - This is a technique that transforms or repackages a pool of assets on the balance of a bank into securities that can be re-sold to investors in the capital market. But this approach is only well suited for loans that have standardized payment schemes and similar credit risk characteristics.
4. Financial analysis techniques for acceptation or refusal decisions of credit loans.
5. Insurance products
6. Guarantees
7. Letters of credit

As the traditional ways of credit risk management is not at the heart of our subject it is enough just to give the names of the techniques. We will not mention traditional ways in detail. But it may be useful to remark that traditional ways are less effective during periods of economic downturn as mentioned at the beginning of Chapter II.

IV. 2. Credit Derivatives

Credit derivatives are contracts where the payoff depends on the creditworthiness of one or more commercial or sovereign entities. In this part we will explain the most used credit derivatives. Credit derivatives are not standardized but privately negotiated two sided contracts. The most important feature of credit derivatives is that they allow banks and financial institutions to manage their exposure to credit risk. Suppose that a bank is concerned that a customer may not pay a loan. To protect itself from credit loss, the bank can transfer credit risk to another party and keep the loan on its books with the use of credit derivatives. This way of protection can be used for any debt instrument or a group of instruments. But the condition is that an objective default price must be determined for the instruments. With the use of credit derivatives, two parties of the credit risk can achieve various objectives such as reduction of risk concentrations in their portfolios, and access to a credit portfolio without actually making the loans. With the use of credit derivatives, an institution can manage its credit risk flexibly or get yields by purchasing synthetic credits. Of course credit derivatives cannot decrease credit risk to zero. Suppose that a company transfers its credit risk to another company. Now, creditworthiness of new company is important. However, in general the credit risk is transferred to AAA rated corporations. Those corporations are mainly special purpose corporations or vehicles and named as SPCs or SPVs. The most used credit derivatives are Credit Linked Notes (CLNs), Total Return Swaps (TRSs), Credit Default Puts, and Credit Spread Options.

According to International Swaps and Derivatives Association (ISDA), credit derivatives market has rosen up 128% in July 2005 compared with the year before. In that month credit derivatives market has exploited 48%, according to June 2005. This growth in credit derivatives shows that financial institutions and banks find, use of credit derivatives advantageous.

Credit derivatives have emerged as a major risk management tool in recent years. The total volume of credit derivatives market is supposed to exceed $75 billion. In the past credit derivatives were mainly used by banks but at present they are used by various kinds of institutions such as insurance companies, hedge funds, mutual funds, pension funds, corporate treasuries etc. At the beginning, credit derivatives were used by financial institutions to manage their illiquid credit concentrations and to use default puts. At present they are mainly used to hedge credit risk exposure. Present derivative methods were used for emerging market debt and have been applied to corporate bonds and syndicated bank loans. These credit derivatives enable investors to obtain exposure to portfolios, which were not available to them in the past and they provide investors new opportunities of diversification.

There are various reasons for the development of credit derivative market. First of all investors have benn interested in credit derivatives to increase their yields while the credit margins are getting narrower. When investors understood credit derivatives more, the market has growth. Now credit risk is being warehoused in the same way as interest rate risk. At present the most important need for credit derivatives is standardization because over-the-counter players have entered the market and International Swaps and Derivatives Association (ISDA) is doing that.

It is hoped that the size and liquidity of the market will continue growing in the future. With the use of credit derivatives, credit pricing will also be priced more efficiently.

IV.2.a. How Credit Derivatives Are Used To Hedge Credit Risk?

Banks and financial institutions use credit derivatives to unbundle and lay-off the relatively static credit risk on their loan portfolios, and manage syndication and subparticipation risks.

On the other hand as mentioned before, with the maturation of the market, new applications for credit derivatives have been developed. Financial institutions can use credit derivatives for various purposes. Those purposes are:

- Hedge credit risk in M&A transactions,
- Hedge currency convertibility risk,
- Hedge dynamic credit risk,
- Create leveraged positions,
- Increase return of the investment,
- Use credit arbitrage opportunities,
- Create synthetic assets

IV.2.a.1 Hedging Credit Risk in M&A Transactions

Credit derivatives are typically used by financial institutions, in M&A transactions, to hedge the credit exposure on the funding of an acquisition, under bridging finance and syndicated loans. Credit derivatives are also increasingly being used by financial institutions with existing credit exposures to the bidder or fund managers holding debt securities issued by the bidder to protect themselves from the consequences of a potential credit ratings downgrade, where the bidder is acquiring a target of a lower credit quality.

A financial institution that holds a credit spread put option is entitled to sell the spread on a reference credit to the writer of the option, for the amount by which the actual spot spread exceeds the strike price of the option. The amount received from the exercise of the option therefore compensates the holder for any loss of value on the reference credit, due to the fact that the ratings downgrade of the merged entity and the consequent widening of the spread on the reference credit.

IV.2.a.2. Hedging Currency Convertibility Risk

Credit derivatives can also be used to hedge currency convertibility risk. The risk that a government restricts the convertibility of its currency or remittances of foreign currency to offshore parties forms the risk of currency convertibility. In a typical structure, the party subject to currency convertibility risk (for example an investor in local equities) enters into a total rate of return swap whose pay-out is linked to the credit quality of a proxy asset, usually debt securities issued by the sovereign. The investor pays the derivatives dealer, an amount equivalent to the return on the proxy asset in exchange for the payment of an amount referable to the investor's cost of carrying its local investment. If an appropriate proxy asset has been selected, the imposition of currency controls should lead to a fall in the value of the proxy asset. The consequent reduction in the investor's swap obligations and the concomitant increase in the dealer's net obligations should thus compensate the investor for any fall in the value of its investment, due to the currency controls.

IV.2.a.3. Hedging Dynamic Credit Risk

Credit derivatives are generally used to manage static credit exposures, i.e. the credit risk on bank loans. But financial institutions may also use credit derivatives to manage the dynamic credit risk on market instruments, primarily other over-the-counter derivatives. Market instruments are marked-to-market on a regular basis, meaning that not only the level of credit exposure but also which of the counterparties is obligated to the other may change from valuation to valuation.

A derivatives dealer can protect itself from a ratings downgrade of its counterparty or other credit events, by entering into a credit default swap with a third party, where the pay-out to the dealer under the swap is linked to the mark-to-market value of the market instrument at the time of the occurrence of the credit event. Credit derivatives thus provide an alternative to unwinding derivatives positions where a credit event such as a ratings downgrade has led to an increase in the dealer's credit exposure and caused the dealer to breach its internal risk management guidelines.

IV.2.a.4. Creating Leveraged Positions

Credit derivatives, such as total rate of return swaps, can be used to create leveraged positions. As it will be mentioned in the coming sections, in a total rate of return swap, one of the counterparties pays the other, the amount of the return on a reference credit, and gets periodic interest payments. The first counterparty is consequently able to lay-off the credit risk on the reference credit by the receipt, from the second counterparty, of a guaranteed minimum rate of return.

The loan is discharged through the "sale" of the reference credit on maturity, with the second counterparty retaining any increase in value or absorbing any fall in value. Indeed, in practice, total rate of return swaps are more often used to create leveraged exposure to reference credits, rather than to hedge the credit risk on such credits.

IV.2.a.5. Increasing Return of the Investment

A fund manager who wants to increase the return of his investment purvhases relatively high yielding, undervalued debt securities. Now investors can also do this by entering a credit default swap transaction. In this way the investor doesn't have to face the costs of actually acquiring the securities.

Basket-linked credit default swaps are generally structured on a first-to-default basis. This means that if a credit event happens for any security in the basket the value of the redemption payment decreases. On the other hand these swaps offer coupons better than those of underlying securities. So, although the swap has a lesser quality than the underlying securities because of their first-to default structure, it offers enhanced coupons.

IV.2.a.6. Using Credit Arbitrage Opportunities

Credit derivatives can also be used to exploit funding and capital arbitrage opportunities.

The cost of funding for lower rated banks is greater than that of highly rated banks. Because of this, it is difficult for low rated banks to get positive spreads on loans they make to high rated corporations. So low rated banks have two alternatives. They will either make unprofitable loans to high rated corporations or they won't enter a credit relation with those institutions. In the first case they won't be able to make high profits. In the second case, they will have a credit portfolio, formed of low rated debtors and this reduces the quality of the portfolio.

Credit derivatives, solve this problem easily. They enable low rated banks to arbitrage the funding difference between highly rated banks. A lower-rated bank sells protection with the help of a credit default swap and then assumes the credit risk on a loan to a highly rated corporation is made by a higher rated bank. This kind of a transaction is beneficiary for both banks. A loan needs to be funded but a credit default swap doesn't. So credit default swap minimizes the effect of lower rated bank's higher cost of funding. And with credit default swap transaction, the bank's quality of credit portfolio increases because the counterparty is a higher rated bank. From the other bank's point of view, the transaction is also advantegous. This bank diversifies its credit portfolio. And if the fee paid for the counterparty of the swap is less than the spread on the loan it maximizes its relative funding advantage.

Banks can also use credit derivatives to arbitrage different risk capital requirements. For example, when a bank in Turkey makes an on-balance sheet loan to a corporation, it is required to include the loan in its banking book and hold a certain amount of risk capital. On the other hand, if the bank sells protection with the help of a credit default swap, it faces the same amount of risk but will need less risk capital requirements.

IV.2.a.7. Creating Synthetic Assets

Credit derivatives can also be used for creating synthetic assets. These synthetic assets, called "credit-linked notes", fall into two categories:

- Credit-linked structured notes, which are created by embedding credit derivatives in debt securities,
- Synthetic credit-linked notes, which are created by issuing debt securities against credit derivatives.

IV.2.b. TYPES OF CREDIT DERIVATIVES

The kinds of credit derivatives are increasing day by day but there are four main types of credit derivatives: Total Return Swaps, Credit Default Swaps, Credit Spread Options and Credit Linked Notes. There are also some other derivatives such as

Collateralized Debt Obligations, Asset Linked Trust Securities and Chase Secured Loan Trust Loans.

We will now discuss these credit derivatives except credit default swaps as they will be mentioned in the next chapter in more detail.

IV.2.b.1. Total Return Swaps (TRSs)

A Total Return Swap is a derivative instrument that allows an investor to receive the total economic return of an asset (income plus or minus any change in capital value) without actually buying the asset. Figure 3 is a diagram of TRS cash flows. One party pays the total economic return on a notional amount of principal to another party and gets periodic fixed or floating rate payments plus some spread in return. The underlying reference credit can be any financial asset, basket of assets or an index (for example LIBOR). The basic structure of Total Return Swaps is as described. However, there may be many variations on this basic structure. For example, a basket of assets instead of a single credit can be used in a Total Return Swap. Maximum and minimum levels for the floating rate of the structure can be set by embedded caps on a reference credit. Maturities of these swaps generally run from one to three years.

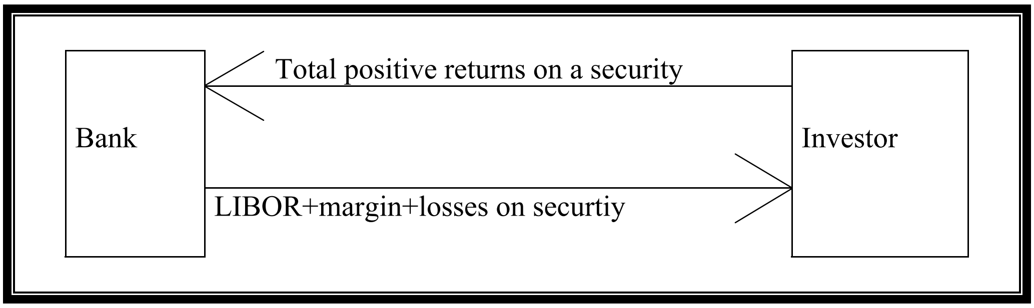


Figure 3: Total return swap

Banks and other financial institutions use total return swaps to transfer risk exposure of an asset to another interested party. Investors seeking exposure to a bank portfolio use TRSs to increase their yield. For example, a bank may agree to pay total return on a $50 million loan portfolio to an insurance company in exchange for semi-annual payments of LIBOR plus 100 basis points. This allows the bank to reduce its exposure to the credit risk portion of the portfolio without selling the loans. The insurance company, on the other hand, obtains exposure to the portfolio without bearing the expense of originating and administering these loans, except via the bank's margin on the swap. The swap enables banks to keep the entire asset on their books, but adjusts the amount of credit exposure as they want. Why banks choose such a transaction while returns of assets are such important and carefully analyzed. There are various reasons. Banks may want to move as much off their balance sheet as possible. Or in some cases they want to keep the loans on their books for customer relationship concerns, or they may be wanting to keep client confidentiality.

Investors can leverage and diversify their portfolios to achieve higher yields by taking on this credit exposure. A Total Return Swap enables the investor to make loans synthetically without the administrative burden of documenting the loan agreement and periodically resetting the interest rate. TRSs can provide an extremely economic way of using leverage to maximize return on capital. The investors do not have to put up $50 million to gain exposure to a $50 million bank portfolio. The exposure on an interest rate is not as large as its notional principal amount since only the respective interest payments are made. Only the total return of the portfolio is exchanged with the fixed or floating semiannual payments.

IV.2.b.2. Credit Spread Options (CSOs)

Credit spread options are option contracts where the payoff depends on either a particular credit spread or the price of a credit-sensitive asset. The structure of the options are so that they end if the underlying asset defaults. A trader who wants to be protected against an increase in a spread and a default, then he must use both a credit spread option and another credit derivative like a credit default swap.

To buy or sell an option on a borrower's credit spread provides an opportunity to gain exposure on the borrower's future credit risk. One can lock in the current spread or earn premium for the risk of adverse movement of credit spreads. It also presents a method of buying securities on a forward basis at favorable prices. Credit Spread Options are normally associated with bonds, which are priced and traded at a spread over a benchmark instrument of comparable maturity. The yield spread represents the risk premium the market demands for holding the issuer's bonds relative to holding riskless assets like U.S. Treasuries. Options can refer to the borrower's spread over U.S. Treasury Bonds, LIBOR or any other relevant benchmark.

The structure of credit spread options allows investors to buy the bonds at attractive terms. If the option becomes worthless, the total cost of bond decreases at an amount equal to amount of the premium. Otherwise the investor pays for the bond at the chosen strike price. There may be different variations of this, such as

- using options on credit spreads to take position on the relative performance of two different bonds,
- locking in the current spread by buying calls and selling puts on the spread with the possibility of earning a premium in the transaction

This structure also allows investors to take a position in the underlying assets synthetically rather than buying assets in the cash market.

With the use of credit spread options, investors are also protected from an event of a large, unfavorable credit shift. Spreads should move to reflect any downgrading in the credit rating. End users who purchased spread options will be able to cash in even though the referenced credit has not defaulted.

IV.2.b.3.Credit Linked Notes (CLNs)

The Credit Linked Note market is one of the fastest growing areas in the credit derivatives sector. The coupon or price of a credit linked note is linked to the performance of a reference asset. With the help of credit linked notes borrowers hedge credit risk and investors have the opportunity of receiving higher yield by facing credit exposure synthetically.

Credit Linked Notes are created by a Special Purpose Company (SPC), or trust, which is collateralized with AAA-rated securities. Investors buy the securities from the trust that pays a fixed or floating coupon during the life of the note. At maturity, the investors receive par value if the referenced credit doesn't default or declare bankruptcy. If a credit event occurs the investors receive just the recovery value. The investor sells the credit protection in exchange for higher yield on the note.

The trust also enters into a default swap with a deal arranger. In the case of default, the trust pays the dealer par minus the recovery rate in exchange for an annual fee. This annual fee is actually passed on to the investors in the form of a higher yield on the notes. In this structure, the investors can obtain higher yield for taking the same risk as the holder of the underlying reference credit. The investor does, however, take the additional risk of its exposure to the AAA-rated trust. The Credit Linked Note allows a bank to lay off its credit exposure to a range of credits to other parties.

IV.2.b.4. Other Credit Derivatives

IV.2.b.4.1 Collateralized Debt Obligations (CDOs)

A collateralized debt obligation is a way of packaging credit risk. A typical structure of collateralized debt obligation is shown in Figure 4. Using a basket of corporate bonds or bank loans, four classes of securities are formed. These classes are named as tranches. The first tranche has 5% the principal of the portfolio and absorbs the first 5% the default losses. The second and third tranches have 10% the principal and each tranche absorbs the next 10% the default losses. The fourth tranche has 75% the bond principal and absorbs the residual default losses.

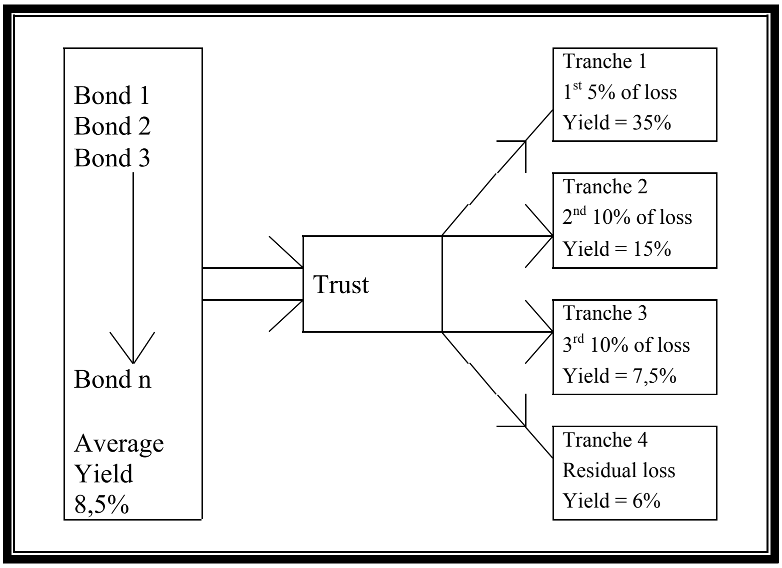


Figure 4: Collateralized debt obligation

Tranche 1 is the most risky and tranche 4 is the least risky one. There is very little risk of default for assets in tranche 4. If default losses on bond portfolio exceeds 25% the principal, the investors in tranche 4 are affected and face losses. Default risk of tranche 3 is more than original portfolio but less than tranche 4. Similarly, if default risks on the original portfolio exceeds 15% the original portfolio just after then investors in tranche 3 are affected. Tranche 1 and 2 are likely to be more risky than the original portfolio. When default losses are between 5% and 15% the original portfolio, they are absorbed by the holders of Tranche 2. Tranche 1 is subject to high default risk. A default loss of 2,5% on the original portfolio translates to a default loss of 50% on tranche 1 and a default loss of 5% or more on the original portfolio leads to a default loss of 100% on tranche 1. The yields in Figure 4, do not account for expected defaults and they are promised yields, not expected yields.

Normally tranche 1 isn't sold out. The other tranches are sold to the market. A Collateralized Debt Obligation provides a way of creating debt with a quality higher than average. Here the correlation between the default probabilities of bonds in the portfolio is also important. As it can easily be seen, the correlation is inversely proportional to the quality of tranches 2,3, and 4.

IV.2.b.4.2. Asset Linked Trust Securities (ALTS)

Asset linked trust securities are special purpose vehicles that allow investors to combine securities, loans and other financial assets with a derivative product to produce customized cash flows. They transform one or more attributes of the underlying asset, or basket of assets, and enable investors to benefit from derivative technology without directly entering into a derivative transaction.

In a typical transaction, each investor purchases an Asset Linked Trust Security certificate, which represents an interest in a separate and independent trust and entitles the investor to participate in the cash flows from the underlying instruments. ALTS trusts can accommodate all kinds of financial assets and credit derivatives and provide the same benefits as the derivative instruments themselves. For example, they allow investors to access the bank loan market without the operational or administrative burdens of syndicated loan participation. They provide a cheaper, simpler and more efficient alternative for investors to diversify their credit exposure through the purchase of a basket of loans or securities and derivatives.

IV.2.b.4.3. Chase Secured Loan Trust Notes (CSLT)

Chase Secured Loan Trust notes offer investors access to the high-yield bank loan market. This market has an advantage that, it generally maintains high returns. Another aspect of this market is that the bank loans are high rated and default rates of these loans are low and stable. This market has been widely unused by investors. The Chase structure uses credit derivatives to offer these investors access to this asset class.

Let's think of an investor who can only invest in investment grade securities. In the Chase structure, the underlying credit derivative is a Total Return Swap between Chase and a trust. Chase pays the trust the total return on a loan portfolio of say $100 million, which yields LIBOR plus 250 basis points. On the other hand, Chase receives LIBOR plus 100 basis points from the trust. An investor who purchases a tranche of the CSLT in the form of a note receives the same return on the loan portfolio that is received by the trust from Chase on the TRS. For this return, the investor does not put up the total $100 million as would be required to participate in actual loan syndication. Rather, the investor pays $20 million for the tranche, which is used by the trust to purchase treasuries to post as collateral against the trust's payment on the TRS. When all the cash flows are broken down on the transaction, including the five times leverage of the $20 million for access to the $100 million loan portfolio plus the yield on the treasuries of 6 percent, the investor generates a total yield in this example of 13.5 percent.

CHAPTER V

CREDIT DEFAULT SWAPS

Before beginning credit default swaps, we want to explain why we chose credit default swaps to study among other credit derivatives. As we previously stated credit derivatives market has been a geometrically growing market. According to the 2002 Credit Derivatives Report of the British Bankers' Association, the credit derivatives market grew from $40 billion outstanding notional value in 1996 to an estimated $1.2 trillion at the end of 2001. The same report indicates that single name credit default swaps (CDSs) accounted for roughly 45% the overall credit derivatives market.

According to MarketAxess which is an electronic trading platform, credit default swaps are so popular that trading volumes in CDS by July 2005, is greater than those of trading in underlying cash bonds by a considerable margin. It estimates the daily trading in the CDS market between banks and clients such as hedge funds is now worth $30bn – more than twice the level of a year ago. Daily inter-bank CDS trading volumes are now believed to be worth another $20bn.

According to data from Risk Waters Group, market share of credit derivatives at the end of 2000 was as in the table below. Although the data is from an old study, to our knowledge today credit default swaps have still the greatest share among all credit derivatives.

Table 4: Percentage of credit derivatives among all transactions at December 2000

Credit Derivative Type	**Percentage**
Credit default swaps (including basketlinked credit default swaps)	50%
Credit-linked notes: credit-linked structured notes (including principal-protected credit-linked notes)	9%
Credit-linked notes: synthetic credit-linked notes	26%
Credit spread products (including credit spread options and credit spread forward contracts)	3%
Total rate of return swaps	12%

Another information about growth of CDS market is that, according to the International Swap and Derivatives Association, the total notional amount of interest rate and currency derivatives as of the end of 2003 stood at $142.3 trillion, while the total notional amount of credit default swaps outstanding was $3.58 trillion. In other words size of CDS market was 2,4% the overall derivatives market. This percentage was 1% at the end of 2000. As another sign of growth, it may be noted that size of credit derivatives became bigger than that of equity derivatives market at the end of 2003.

As it is seen the most common form of credit derivative continues to be the credit default swap. Usman Ali (2001) argues that the market has shifted decisively towards more “exotic” credit-linked notes but as it is said above today credit default swaps are still the most important credit derivatives in financial markets.

Especially in emerging markets, credit default swaps are seen to be the most important derivatives in the near future. According to Deutsche Bank, in emerging markets credit default swaps account for 85% credit derivatives market (2004).

Credit default swaps are newly known in Turkey and banks have already started to meet this credit derivative. In years 2000, 2001 and 2002, numbers of quotes on CDSs were 146, 471 and 475 respectively. It can be interpreted that credit default swap market will grow much more in the future.

After stating importance of credit default swaps in credit derivatives market we can start getting closer to credit default swaps. A credit default swap is a kind of insurance against credit risk. The buyer of protection pays a fixed fee or premium to the seller of protection for a period of time and if a certain credit event occurs, the protection seller pays compensation to the protection buyer. The credit event may be a bankruptcy of a company, or a default of a bond or other debt issued by the reference entity. If no credit event occurs during the term of the swap, the protection buyer continues to pay the premium until maturity.

CDSs can also be used as a way to increase exposure to credit risk. Risk profile of a CDS is mainly similar to a corporate bond of the reference entity but there are some differences. First of all a CDS does not require an initial funding. This property of CDSs allows leveraged positions. Secondly a CDS transaction can be entered where a cash bond of the reference entity of a particular maturity is not available. And finally, a protection buyer can create a short position by entering a CDS transaction.

The buyer of a CDS makes periodic payments to the seller until the end of the life of the CDS or until a credit event occurs. A credit event usually requires a final accrual payment by the buyer. The swap is then settled physically or in cash. If physical delivery is stated in the CDS, the swap buyer delivers the bonds to the seller and receives the par value of the bonds. Otherwise, the calculation agent polls dealers to determine the mid market price of the reference obligation some specified number of days after the credit event. If the mid market price is X then the cash settlement is (100 – Z)% of the notional principal. The cash flows of a credit default swap are illustrated in the figure below.

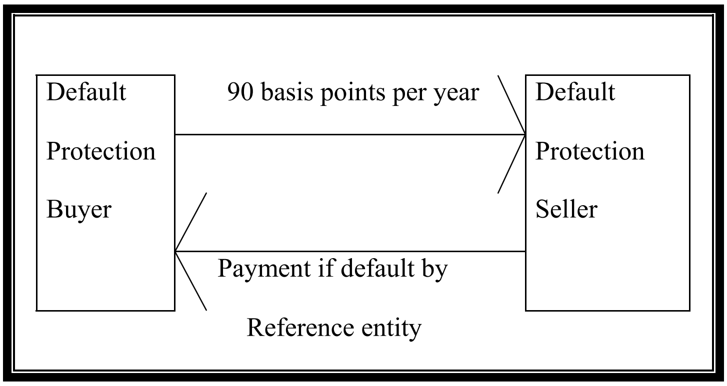


Figure 5: Credit Default Swap

V.1. GLOBAL CDS MARKET

The CDS market originally evolved from privately tailored agreements between banks and their customers. At the beginning the credit default swaps were not standardized. CDS market is an over-the-counter market so it is not known exactly when credit default swap contracts have started to be transacted.

The most important players in the CDS market are commercial banks. Traditionally, a bank's business has involved credit risk. Because banks loans to corporations. With a credit default swap transaction a bank may transfer risk while keeping the assets in its balance sheet without involving borrowers. Credit portfolios of banks are often concentrated in certain industries or geographic areas. Banks may also use credit default swaps to diversify their portfolios. In credit derivatives market Banks are the net buyers.

As stated before, at the beginning banks were the primary players of the market but insurance companies are also becoming participants of the market increasingly. Other players of credit default swaps are financial guarantors and global hedge funds.

Sovereigns had the biggest share as reference entities in the beginning of CDS market, but their share had declined from over 50% in 1997 to less than 10% in 2003. On the other hand, share of corporates as reference entities has increased in that period. The share of corporates as reference entities was 70% at the end of 2003.

V.2. HOW DO CREDIT DEFAULT SWAPS WORK?

As described above, in a credit default swap, the buyer and the seller of protection enter into a contract where the protection buyer pays a fixed premium for protection against a certain credit event, such as a bankruptcy of the reference entity, or a default on debt issued by the reference entity. Usually there is no exchange of money when two parties enter in the contract, but they make payments during the term of the contract, thus explaining the term "credit default swap".

The premium paid by the protection buyer to the seller is called spread. It is quoted in basis points per annum of the contract's notional value and paid quarterly. It must be noted that these spreads are not the same type of concept as "yield spread" of a corporate bond to a government bond. CDS spreads are the annual price of protection quoted in bps of the notional value. Periodic premium payments allow the protection buyer to deliver the defaulted bond at par or to receive the difference of par and the bond's recovery value. We can say that a CDS is like a put option written on a corporate bond. The protection buyer is protected from losses incurred by a decline in the value of the bond as a result of a credit event. Similarly, we can say that CDS spread can be viewed as a premium on the put option, where payment of the premium is spread over the term of the contract.

There are no limits on the size or maturity of CDS contracts but contract sizes are generally between $10 million to $20 million. And maturity is generally between one to ten years. The most common maturity is 5 year.

At credit default swap transactions, the credit events are predefined. According to ISDA there are six kinds of credit events but bankruptcy, failure to pay and restructuring are accepted as most important ones.

Bankruptcy, as clearly known, is the insolvency or inability of the reference entity, to repay its debt. Failure to pay occurs when the reference entity, after a certain grace period, fails to pay principal or interest. Restructuring is a change in the comditions of debt that are not advantageous for the creditors.

Among these credit events the most problematic one is restructuring. Because, it is not generally clear which changes are adverse for creditor. So, some players prefer excluding restructuring as a credit event or restricting the definition of restructuring.

Presently, one of four options for restructuring is being used as in credit default swaps.

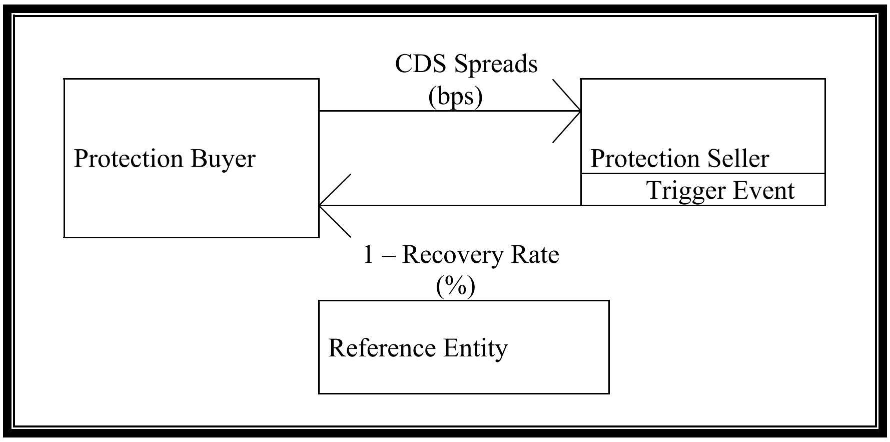


Figure 6: Trigger Event

V.3. WHAT HAPPENS IF CREDIT EVENTS HAPPEN?

The first step taken after a credit event occurs is a delivery of a "Credit Event Notice," either by the protection buyer or the seller. Then, the compensation is to be paid by the protection seller to the buyer by physical or cash settlement. The type of settlement is specified in the contract. In general, physical settlement is used more than cash settlement in the market.

In a physical settlement, the protection seller buys the distressed loan or bond from the protection buyer at par. The bond or loan bought by the seller is named as the "deliverable obligation." Physical settlement generally occurs 30 days after the credit event.

In a cash settlement, the amount that must be paid by the seller is determined as the difference between the notional of the credit default swap and the final value of the reference obligation. As mentioned, cash settlement is less common because it is difficult to find the quotes for the reference credit. A cash settlement typically occurs no later than five business days after the credit event.

V.4. STANDARD DOCUMENTATION FOR THE CDS

At the beginning of usage of credit default swaps, CDS contracts were not standardized and this caused many problems. As all the points were not made clear, disagreements took place between sellers and buyers in case of credit events. If we think a credit default swap contract as an insurance policy, the protection buyer is the insured and seller is the insurance company. So, the first one would want to receive as much as possible while the latter would search for ways to escape from payments. And, unclear contracts were causing disagreements between sellers and buyers of protection.

The situation described above blocked the growth of the credit default swap market. In 1999, ISDA published a Master Agreement designed for credit derivatives contracts, and later some amendments that made improvements. In 2002 ISDA published a new Master Agreement and in 2003 new credit derivatives definitions. With the help of publications mentioned, the problems seen in the credit default swaps markets have been solved in a great extent.

According to definitions of ISDA 2003, a bankruptcy occurrs only if it results in the default of the reference entity's obligations. In 1999 definitions it was stated that, if a company has taken an action towards a default it would be accepted as bankruptcy. According to the new definitions decision of bankruptcy is made by a regulatory institution so it is hoped that less disagreements will take place between counterparties.

Restructuring is a problematic issue as mentioned before. Because, for example some restructuring may not lead to losses for investors. Or, if there is a loss, it may very difficult to determine the amount of it. Due to new ISDA agreement there are four options in CDS contracts for restructuring:

· No Restructuring: Restructuring is excluded from the contract.

· Full Restructuring: With this option, protection buyer has the right to deliver bonds after restructuring.

· Modified Restructuring: Modified restructuring limits deliverable obligations to bonds with maturity of less than 30 months after a restructuring.

· Modified Modified Restructuring: As modified restructuring was criticized that it was too strict with respect to deliverable obligations, modified-modified restructuring was developed. This option allows deliverable obligations with maturity up to 60 months after a restructuring.

V.5. VALUATION OF CREDIT DEFAULT SWAPS

Pricing of contracts was more an art than a science in the early days of the CDS market. Today, however, pricing is more quantitatively based, using parameters such as the likelihood of default, the recovery rate in case of default, and some consideration for liquidity, regulatory, and market sentiment about the credit. In theory, CDS spreads should be closely related to bond yield spreads, or excess yields to risk-free government bonds.

There are various methods for pricing credit default swaps. As we will not deal with pricing credit default swaps in a very complicated and technical way, in this part we will just give three different methods, to give an idea.

V.5.a. Pricing Method 1 (Hull et al (2004)):

We assume that the notional principal is \$1 and default events, interest rates and recovery rates are mutually independent. We also assume that the claim in the event of default is the face value plus accrued interest. Suppose first that default can occur only at times t1, t2, ..., tn. Let's define:

T: Life of credit default swap in years

P1: Risk-neutral probability of default at time ti.

Ř: Expected recovery rate on the reference obligation in a risk-neutral world (this is assumed to be independent of the time of the default)

u(t) : Present value of the payments at the rate of \$1 per year on payment dates between time zero and time t

$e(t)$: Present value of a payment at time t equal to $t - t^*$ dollars, where t^* is the payment date immediately preceding time t (both t and t^* are measured in years)

$v(t)$: Present value of $1 received at time t

w : Payments per year made by credit default swap buyer per dollar

s : Value of w that causes the credit default swap to have a value of zero

π : The risk-neutral probability of no credit event during the life of the swap

$A(t)$: Accrued interest on the reference obligation at time t as a percent face value

The value of π is one minus the probability that a credit event will occur. It can be calculated from the pi:

$$\pi = 1 - \sum_{i=1}^{n} pi$$

The payments last until a credit event or until time T, whichever is sooner. The present value of the payments is therefore

$$w\sum_{i=1}^{n} ([u(ti) + e(ti)]pi + w\pi u(T)$$

If a credit event occurs at time ti, the risk-expected value of the reference obligation, as a percent of its value, is [1 + A(ti)] Ř. The risk-neutral expected payoff from the CDS is therefore

$$1 - [\ 1 + A(ti)]\ \check{R} = 1 - \check{R} - A(ti)\ \check{R}$$

The present value of the expected payoff from the CDS is

$$\sum_{i=1}^{n}[1 - \check{R} - A(ti)\ \check{R}]piv(ti)$$

and the value of the credit default swap to the buyer is the present value of the expected payoff minus the present value of the payments made by the buyer:

$$\sum_{i=1}^{n}[1 - Ř - A(ti)\, Ř]piv(ti) - w\sum_{i=1}^{n}[u(ti) + e(ti)]pi + w\pi u(T) \tag{11}$$

The CDS spread, s, is the value of w that makes this expression zero:

$$S = \frac{\sum_{i=1}^{n}[1 - Ř - A(ti)\, Ř]piv(ti)}{w\sum_{i=1}^{n}[u(ti) + e(ti)]pi + w\pi u(T)} \tag{12}$$

The variable s is referred to as the credit default swap spread or CDS spread. It is the payment per year, as a percent of the notional principal, for a newly issued credit default swap.

We can extend the analysis to allow defaults at any time. Suppose that q(t) is the risk-neutral default probability density at time t. Equation (12) becomes

$$S = \frac{\int_{0}^{T}[1 - Ř - A(t)\, Ř]q(t)v(t)dt}{w\int_{0}^{T}[u(ti) + e(ti)]pi + w\pi u(T)} \tag{13}$$

V.5.b. Pricing Method 2 (Whetten M. et al (2004))

A typical CDS contract usually specifies two potential cash flow streams – a fixed leg and a contingent leg. On the fixed leg side, the buyer of protection makes a series of fixed, periodic payments of CDS premium until the maturity, or until the reference credit defaults. On the contingent leg side, the protection seller makes one payment only if the reference credit defaults. The amount of a contingent payment is usually the notional amount multiplied by (1 – R), where R is the recovery rate, as a percentage of the notional. Hence, the value of the CDS contract to the protection buyer at any given point of time is the difference between the present value of the contingent leg, which the protection buyer expects to receive, and that of the fixed leg, which he expects to pay, or,

Value of CDS (to the protection buyer) = PV [contingent] – PV [fixed (premium)]

In order to calculate these values, one needs information about the default probability (i.e. credit curve) of the reference credit, the recovery rate in a case of default, and risk-free discount factors (i.e. yield curve). A less obvious contributing factor is the counterparty risk. For simplicity, we assume that there is no counterparty risk and the notional value of the swap is $1 million.

First, let's look at the fixed leg. On each payment date, the periodic payment is calculated as the annual CDS premium, S, multiplied by di, the accrual days (expressed in a fraction of one year) between payment dates.

However, this payment is only going to be made when the reference credit has not defaulted by the payment date. So, we have to take into account the survival probability, or the probability that the reference credit has not defaulted on the payment date. For instance, if the survival probability of the reference credit in the first three months is 90%, the expected payment at t1, or 3 months later, is q(ti)diS =

0,9(0,25)(160) = 36 bps where q(t) is the survival probability at time t. Then, using the discount factor for the particular payment date, D(ti), the present value for this payment is D(ti)q(ti)Sdi. Summing up PVs for all these payments, we get

$$\sum_{i=1}^{N} D(ti)q(ti)Sdi \qquad (14)$$

There is another piece in the fixed leg - the accrued premium paid up to the date of default when default happens between the periodic payment dates. The accrued payment can be approximated by assuming that default, if it occurs, occurs at the middle of the interval between consecutive payment dates. Then, when the reference entity defaults between payment date ti-1 and payment date ti, the accrued payment amount is Sdi/2. This accrued payment has to be adjusted by the probability that the default actually occurs in this time interval. In other words, the reference credit survived through payment date ti-1, but not to next payment date, ti. This probability is given by {q(ti-1)- q(ti)}. Accordingly, for a particular interval, the expected accrued premium payment is {q(ti-1)- q(ti)}S di/2.

Therefore, present value of all expected accrued payments is given by:

$$\sum_{i=1}^{N} D(ti)\ \{q(ti-1)- q(ti)\}S\ (di/2) \qquad (15)$$

Now we have both components of the fixed leg. Adding (14) and (15), we get the present value of the fixed leg:

$$PV\ [fixed\ leg] = \sum_{i=1}^{N} D(ti)q(ti)Sdi + \sum_{i=1}^{N} D(ti)\ \{q(ti-1)- q(ti)\}S\ (di/2) \qquad (16)$$

Next, we compute the present value of the contingent leg. Assume the reference entity defaults between payment date ti-1 and payment date ti. The protection buyer will receive the contingent payment of (1-R), where R is the recovery rate. This payment is made only if the reference credit defaults, and, therefore, it has to be adjusted by {q(ti-1)- q(ti)}, the probability that the default actually occurs in this time period. Discounting each expected payment and summing up over the term of a contract, we get:

$$PV\ [\text{contingent leg}] = (1-R) \sum_{i=1}^{N} D(ti)\ \{q(ti-1) - q(ti)\} \tag{17}$$

Plugging equation (16) and (17) into the equation in the beginning, we arrive at a formula for calculating value of a CDS transaction.

When two parties enter a CDS trade, the CDS spread is set so that the value of the swap transaction is zero (i.e. the value of the fixed leg equals that of the contingent leg). Hence, the following equality holds:

$$\sum_{i=1}^{N} D(ti)q(ti)Sdi + \sum_{i=1}^{N} D(ti)\ \{q(ti-1) - q(ti)\} S\ (di/2) = (1-R) \sum_{i=1}^{N} D(ti)\ \{q(ti-1) - q(ti)\}$$

Given all the parameters, S, the annual premium payment is set as:

$$S = \frac{(1-R)\sum_{i=1}^{N} D(ti)\ (qi-1\ -\ qi)}{\sum_{i=1}^{N} D(ti)\ q(ti)di + \sum_{i=1}^{N} D(ti)\ (qi-1\ -\ qi)\ (di/2)} \tag{18}$$

V.5.c. Pricing Method 3 (Lee P. B. et al (2003))

The default process is usually modeled by assuming that the corporate assets undergo a simple random walk and the first time the assets fall below a threshold T default occurs [Black and Cox (1976), Longstaff and Schwartz (1995), Leland and Toft (1996), etc.]. A company may have several types of debt, type i contributing Di to a total debt D (Pi Di = D). The debt holders weighted, by debt fraction, average recovery fraction (i.e., total recovery fraction) R is equal to T/D. If default occurred when the assets first passed a threshold equal to D then the total recovery fraction would be one. However, the total recovery fraction is typically considerably less than one and its precise value is not known until after the default actually occurs. Hence the default threshold T or equivalently the total recovery fraction R should be treated as a random variable. Recently first passage models have been generalized to include a fluctuating recovery [Pan (2001), Finkelstein, et. al. (2002)]. Expected default probabilities and par spreads ci for credit default swaps have been computed using a first passage model with a fluctuating total recovery fraction R. The expected default probability, PD(t), for example, is calculated by taking the usual first passage time expression PD(t|R) and taking its expected value over possible values for R.

Since the recovery fraction for the i'th type of debt, Ri is not equal to R it is usually treated as a fixed independent quantity in the calculation of par spread, ci for a default swap on corporate bonds which form the i'th debt type1. This assumption neglects the empirical observation that recovery fractions for different classes of bonds typically depend strongly on the total recovery, and there is considerable uncertainty regarding the expected recovery for each class. We argue that the Ri's are actually functions of R and the main purpose of this part is to study the implications of this relationship for the pricing of credit default swaps on different subordination classes of bonds. Clearly the R_i cannot be completely independent of R. For example, since

$$\sum_i R_i D_i = RD \tag{19}$$

if R and the R_i go between zero and one then R = 0 implies that all of the R_i are zero and R = 1 then all of the R_i = 1.

In a simple scenario where debt of type i is subordinate to debt of type i − 1 we find the functional dependence of the R_i on R and use it to compute the par credit default swap spreads, c_i. Since the default probability PD(t|R) depends on R and the recovery fractions R_i now also depend on R there are correlations between these two quantities which play an important role. We examine the significance of these correlations and find that they cause a substantial decrease in default swap par spreads. The effect is very dramatic for the most senior debt.

Debt cushion for debt of type i refers to the proportion of total debt occupied by those junior to it [Van de Castle and Keisman (1999)]. The simple scenario discussed here relates recovery fractions R_i to R in a way that incorporates the impact of debt cushion on the pricing of credit default swaps and we find that expected recovery rates increase substantially as the debt cushion increases.

Let's take the corporate assets V_t to undergo the Ito process,

$$dV_t/V_t = \sigma dW_t + \mu dt \tag{20}$$

where,

$$E[(dWt)^2] = dt \tag{21}$$

and μ is the coefficient of a drift term. The stochastic process for log(Vt) is obtained using Ito’s lemma.

$$D(\log Vt) = \sigma dWt + (\mu - \frac{\sigma^2}{2})dt \tag{22}$$

where log denotes the natural logarithm. Integrating over time

$$Vt = V0\exp(\sigma Wt + \mu - \frac{\sigma^2}{2})t \tag{23}$$

We set μ = 0 so that the expected value, E[Vt] is independent of time [Pan(2001)]. Default occurs if the assets Vt fall below a threshold T. If the total corporate debt is D, the average recovery fraction weighted by debt fraction (i.e., total recovery fraction) is R = T/D. Because the total recovery fraction is not known at the initial time, the default threshold T or equivalently the total recovery fraction R is taken to be a random variable with probability distribution P(R). The expected survival probability, PS(t), for the fluctuating default threshold case results from weighting the standard (i.e., fixed default threshold) first passage time expression with the probability distribution P(R). The survival condition is Vt > T which implies that,

$$Wt - \frac{\sigma}{2} T > \frac{1}{\sigma} \log \left(\frac{RD}{V0} \right) \tag{24}$$

The survival probability can be deduced from the above condition since it simply leads to a constant drift Brownian motion with an absorbing barrier. Introducing the convenient notation to signify expectations of a quantity f(R) over the recovery probability density function

$$\langle f(R) \rangle = \int_0^1 dRP(R)f(R) \quad (25)$$

the expected survival probability is

$$Ps(t) = \langle Ps\,(t/R) \rangle \quad (26)$$

Where

$$Ps(t) = \phi \left(-\frac{B(R)}{\sqrt{t}} - \frac{\sigma\sqrt{t}}{2} \right) - \exp(-\sigma B(R))\,\phi\,\frac{B(R)}{\sqrt{t}} - \frac{\sigma\sqrt{t}}{2} \,) \quad (27)$$

In equation (27),

$$B(R) = -\frac{1}{\sigma}\,\mathrm{Log}\left(\frac{V0}{DR}\right) \quad (28)$$

and ϕ is the cumulative normal distribution.

$$\phi(a) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{A} dx\,\exp\left(-\frac{x^2}{2}\right) \quad (29)$$

Although there have been reports of recovery rates greater than unity, such events are rare and untypical. Hence, we take the upper limit in the range of integration in equation (25) to be R = 1. When V0/D is significantly greater than unity this causes an unrealistically large suppression of default probabilities at small times. It is straightforward to extend the results presented here to allow for R>1.

The credit default swap par spread ci for a particular type of debt labeled by i can be found by equating the expected loss due to the firm defaulting with the credit default swap payments, which are assumed to be made continuously. We have

$$C_i = \frac{\left\langle \left(1-R_i(R) \right) * \left(1 - P_s(0|R) - \int_0^t ds \frac{\partial P_s(s|R)}{\partial s} e^{(-\check{r}(s)s)} \right) \right\rangle}{\left\langle \int ds P_s(s|R)\, e^{(-\check{r}(s)s)} \right\rangle} \qquad (30)$$

where ř(s) is the spot rate of term s.

In the remainder of this part, we consider a simple scenario for the recovery rates pertinent to different classes of debt at the point of default. Consider N different classes of debts

$$D_i, \quad 1 \le i \le N \qquad (31)$$

in the descending order of seniority such that D1 is the most senior. We have the following constraints on the debts:

$$\sum_{i=1}^{N} D_i = D \qquad (32)$$

$$\sum_{i=1}^{N} R_i D_i = RD \qquad (33)$$

Under the current U.S. bankruptcy legislation, assets of a bankrupt firm are distributed to its creditors according to the Absolute Priority Rule [Gupton and Stein (2002)]. Senior debt holders are able to have a claim on the remaining assets before the junior holders can do so. However, in practice the actual recovery rates may depend on a "plan" agreed upon by the claimants. We apply the Absolute Priority Rule in its strictest sense. We assume that senior holders, when given the chance, are able to claim up to the full recovery rate at which point the next senior holder is able to stake a claim. For example, the most senior holder's recovery rate initially goes as R1 = RD/D1 then caps at 1. The next senior debt holder is unable to recover any amount of the asset until R = D1/D, then he recovers (RD − D1)/D2 until the recovery rate caps at 1. Repeating this argument, one can show that for the i'th subordinate, the recovery fraction can be expressed as

$$Ri(R) = \alpha(R)\,[\,\Theta(\alpha i\,(R)) - \Theta(\alpha i\,(R)-1)] + \Theta(\alpha i\,(R)-1) \qquad (34)$$

$$\alpha i\,(R) = \frac{D}{Di}\left(R - \sum_{j=1}^{i-1} (Dj/D) \right)$$

where $1 \le i \le N$ and $R \in [0, 1]$. Θ is the step function defined in the following manner:

$$\Theta(x) = \begin{cases} 1 \text{ if } x \ge 0 \\ 0 \text{ otherwise} \end{cases} \qquad (35)$$

Obviously, the general expression for the credit default swap par spread ci given in equation (30) can accommodate any form of the recovery rate as a function of the total recovery rate on total debt. The scenario we consider with the recovery rates depending only on the seniority of the debt and the level of debt cushion should prove useful in a general framework for pricing credit default swaps.

V.6. RECOVERY RATE ESTIMATES

Expected recovery rate is the only variable necessary for valuing a credit default swap that cannot be observed in the market. On the other hand, pricing of a plain vanilla credit default swap does not depend on the recovery rate to a high extend. Reason of this is that the expected recovery rate affects credit default swap prices in two ways. It affects the estimates of risk neutral default probabilities and the estimates of the payoff that will be made in the event of a default. And these two effects largely offset each other.

V.7. BINARY CREDIT DEFAULT SWAPS

There are also nonstandard credit default swaps which are sensitive to the expected recovery rate estimate. An example for this is binary credit default swap. Binary credit default swap is structured similarly to a regular credit default swap but the payoff of binary CDS is fixed. For a binary default swap, the probability of default is affected by expected recovery rate but the payoff is not affected. Because of this, the price of credit default swap is sensitive to the recovery rate.

V.8. BASKET CREDIT DEFAULT SWAPS

There are various reference entities in a basket credit default swap. In an add up basket credit default swap, there is a payoff when two of the reference entities default. Actually, a basket credit default swap is the same as a portfolio of regular credit default swaps. Another application is first to default basket credit default swaps where there is a payoff only when the first reference entity defaults. After then no payments are made and CDS doesn't exist anymore.

As it is clear, first to default swaps are sensitive to the default correlation between reference entities. This feature of first to default swaps is similar to collateralized debt obligations. As we mentioned in the section for CLOs the correlation is inversely proportional to the value.

V.9. SELLER DEFAULT RISK

Up to now we have assumed that the probability of default of credit default swap sellers. Now we will mention the effect of default probability of seller of CDS prices.

To explain seller default risk let's consider the position of buyer after the default of seller. Assume that reference entity has not defaulted previously. Now the protection buyer must buy a new CDS from another seller. The life of the new CDS is T – tD, where T is the maturity of the old credit default swap and tD is the time at which the default occurs. The buyer will lose money if the premium of the new credit default swap is greater than the premium of the original one. However, for this to happen, the creditworthiness of the reference entity has to decline significantly. The variables that affect default risk of seller are:

- the extend to which the reference entity's default probability is expected to increase with time
- the correlation between the reference entity and the seller

We think there is no need to discuss in detail but it may be remarked that the impact of seller default risk on CDS price can be measured by Monte Carlo simulation.

CHAPTER VI

APPLICATIONS OF CREDIT DEFAULT SWAPS IN TURKEY

Credit default swaps are a very recent phenomenon in Turkey and banks have already started to enter transactions in this credit derivative. In years 2000, 2001 and 2002, numbers of quotes on CDSs were 146, 471 and 475 respectively. It can be interpreted that credit default swap market will grow in the future.

It is to be noted that, credit default swaps are not very popular among Turkish companies and financial institutions. According to 2003, 2004 and 2005/9 balance sheets of firms just one bank has credit default swap transactions. The amount of assets in portfolio of Turkey Dis Ticaret Bankasi A.S. at the end of periods 2003, 2004 and 2005/9 were 14.020 YTL, 40.500 YTL and 40.320 YTL respectively. Among companies other than banks Dogan Holding had a CDS contract of 324.000 YTL according to 2005/3 balance sheet.

In applications of credit default swaps in Turkey, Turkish Banks are risk buyers. Foreign financial institutions that are in long position in Turkish Bonds, deals CDS contracts with Turkish Banks. Examples of credit default swap contracts in Turkey are given in the Appendix to show how they are used in business life in Turkey. In Turkish applications of credit default swaps, foreign financial institutions that want to decrease their risk exposure on Turkish sovereign bonds, pay premium to private Turkish banks and buy risk protection.

Two examples of credit default contracts between Dbank - M International and DBank – BBank are given in the Appendix. In the contracts Dbank Turkey is the protection seller and M International, BBank are protection buyers that are foreign institutions respectively. (For confidentiality reasons real names of banks are changed)

The underlying asset in the CDS transactions is Turkish Government Eurobond US900123AL40. Maturity date of the asset is January 15, 2030 which is the most active maturity date. Coupon rate of the bonds is 11,875%. Both contracts are defined according to ISDA Credit Derivatives definitions. For the first contract M International pays 3,45% USD20.000.000 calculated semiannually while in the second contract BBank pays 6% USD15.000.000 calculated annually. If pre-defined credit events occur, protection seller (Dbank) will pay total amount of interest and capital of the defined Eurobonds. The credit events are defined as repudiation/moratorium, obligation acceleration, failure to pay, and restructuring in the contracts.

In the next step of our study, we have used the data of credit default swap indices CTURK1U2, CTURK1U5, CTUR1U10 (2, 5 and 10 year Turkish credit default swaps) between 12.10.2000 and 13.4.2005 and most active Turkish Government Treasury Bonds between 2.1.2003 and 13.4.2005. The table that shows correlations between these assets is given below:

Table 5: Correlations between Turkish credit default swaps and Government bonds.

Assets	Correlations
CTURK1U2 – CTURK1U5	0,9909
CTURK1U2 – CTUR1U10	0,9882
CTURK1U5 – CTUR1U10	0,9979
CTUR1U2 – TBOND	0,9535
CTURK1U5 – TBOND	0,9597
CTUR1U10 – TBOND	0,9600

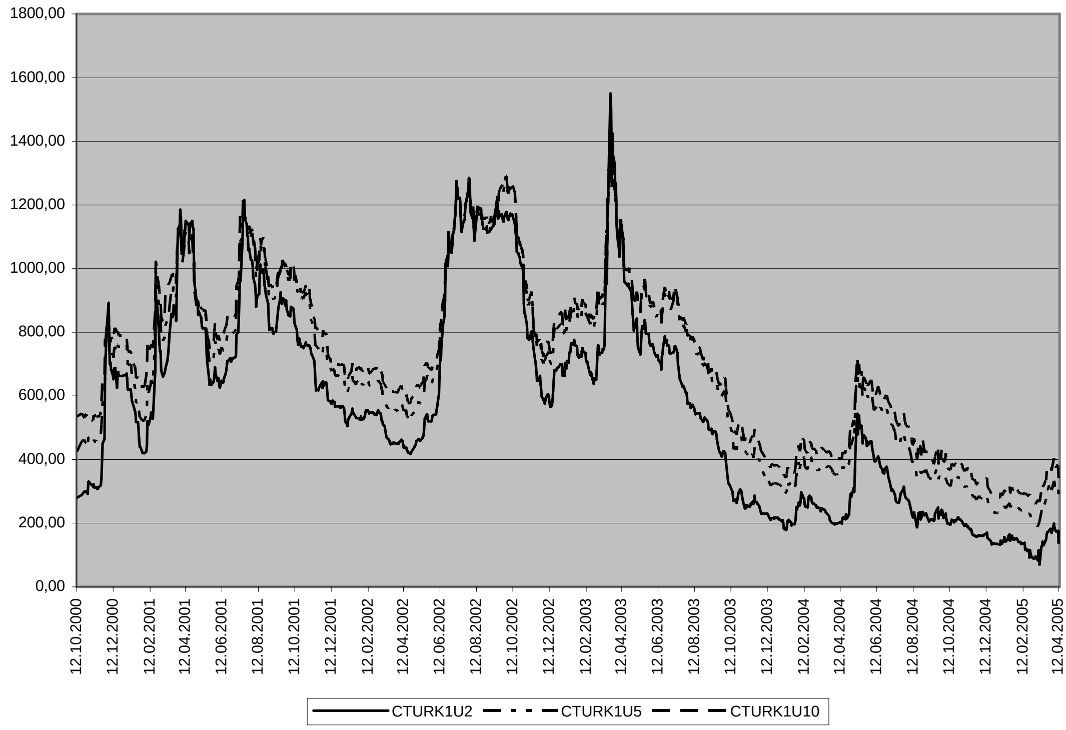


Figure 7. Turkey 2, 5 and 10 year default swaps

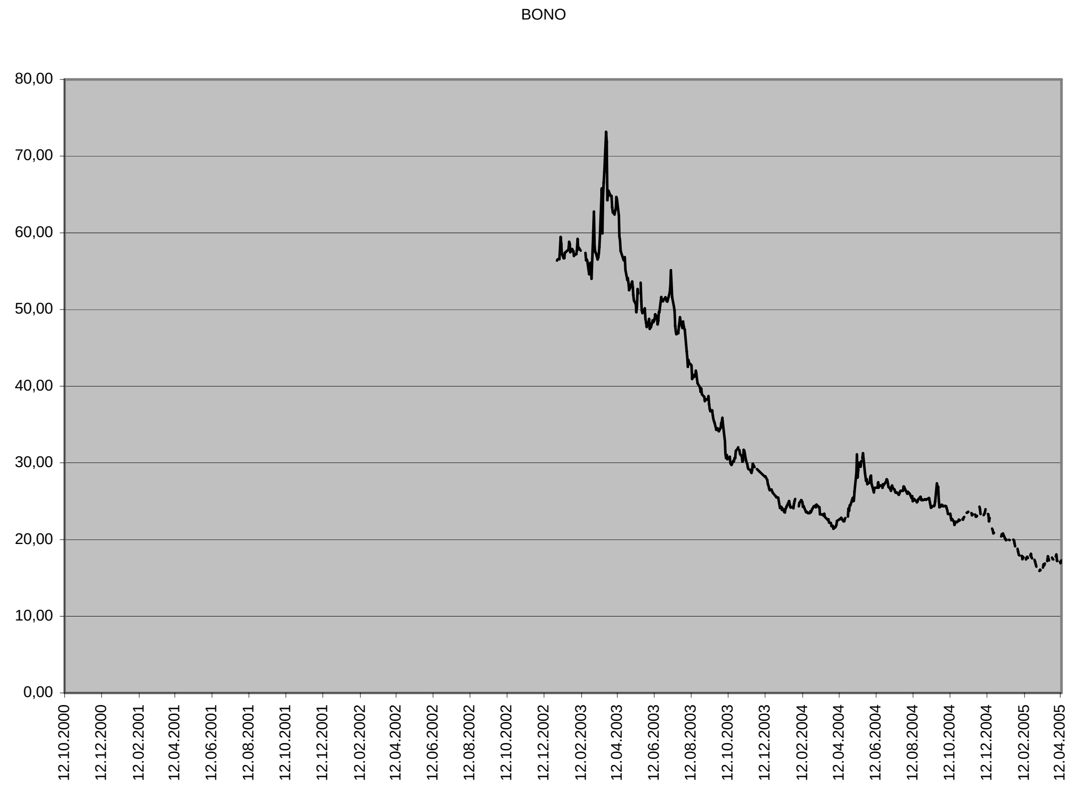


Figure 8. Yearly compound interest rate of most active Turkish T-Bond

As the graph of CDS basis points isobserved, it is seen that, the basis rate is very much correlated with local and global economic conditions. In general, sharp increases of credit default swap basis occur with high probabilities of default of Turkey. It is accepted that, default probability increases with economic, politic, diplomatic or governmental crisis. On the other hand, a sharp increase in the default risk and CDS basis may occur when default probability of any other emerging market increases. For example, in the period of June-August 2001, CDS basis had increased sharply. Besides economic conjuncture of Turkey, the dramatic increase in Argentina default risk had great effect on that.

In February 2001 CDS basis rates increased dramatically to 1.200 bps because of the economic crisis. That was a period when, default probability of Turkish government had increased very much.

In July, Turkish economy hadn't recovered from the effects of February crisis. In addition, US economy slowed down, and default probability of Argentina increased. This caused Russian and Brazilian CDS basis rates to increase. Finally, in the fragile Turkish economy, CDS basis points increased very much.

There are two other sharp increases in CDS basis, one in July 2002 and the other in April 2003. The dramatic increase in July 2002 was because of government crisis and upcoming elections. As it is known, in July 2002 one of the members of the coalition government requested an early election. After that point, election economy was on the scene. And, political uncertainty caused default risk to increase with CDS basis points.

The other sharp increase was seen during Iraq conflict. The reader would remember that, before American occupation in Iraq, Turkish military help had been requested by American government. Acceptance of this request, which had caused many discussions in Turkey, was the first test for the new government. The demand of American government was refused in the senate and this decision caused a short period of stress between Turkish and American governments. This stress caused CDS basis points to increase to their highest level ever.

After this, with the improvement of the relations of Turkey and America, CDS basis decreased uniformly to even under the level before the 2001 economic crisis. In May 2005, there was also an increase in default risk. This was because, at that time, rating institutions explained that negative difference between exports and imports of Turkey had reached to a dangerous level.

Observing the figures above and looking at the correlations between CDS spreads and bond rates, it is easily seen that CDS and bond rates are very much correlated as implied also by Hull et al (2004).

CHAPTER VII

CREDIT DEFAULT SWAPS TURKEY ANALYSIS

VII.1. ARE TURKISH CREDIT DEFAULT SWAPS OVERPRICED?

In this section, we extract default risk of the Turkish government from CDS data. We will use a methodology similar to the one used by Ranciere (2001).

In the previous chapters we have told that, if we don't take counterparty risk into consideration, a credit default swap converts a risky obligation to a riskless obligation. We assume that condition of No Arbitrage holds, so the return of the protected obligation is equal to the risk free interest rate.

Let the risky obligation has a return of Libor + s, so to hedge the credit risk we must buy a credit default swap for a similar duration. Assume that premium of this default swap is ds. We must also take into consideration that, we must finance the long position by repo or another cost of funding. And let the cost of funding be Libor+f.

If we apply the No Arbitrage condition we will get the break even rate for the buyer of credit protection. At the interception of the default swap:

$$LIBOR + s = (LIBOR+f+ds) \Rightarrow ds = s - f$$

On the other hand, seller of protection can fully hedge by selling the bond. For that, the seller must borrow the bonds or lend money in a repo agreement at a rate of LIBOR+f as stated above:

We again use the No Arbitrage condition from the seller's point of view. So we get the equation:

$ds + LIBOR + fs = (LIBOR + s) \Rightarrow ds = s - f$

Assume that the protection is funded by the repo market. The market clearing condition of the repo market gives f=s. Here we must remark that if the protection buyer has a very good rating, the rate of financing the position will be lower than the repo rate.

When repo rates are especially low because most of the traders want to short the bonds, the price of the default swap increases. The protection buyer will accept to pay a more expensive premium, because the obligation will be cheap to fund, and seller can ask for a higher price because of the higher cost of shorting the bonds.

The difference between the default premium and the spread over LIBOR is called the credit-derivatives cash basis.

$Basis = f = ds - s$

From here, the basis is the break-even funding LIBOR spread. Bu there are some other elements that affect the default swap cash basis:

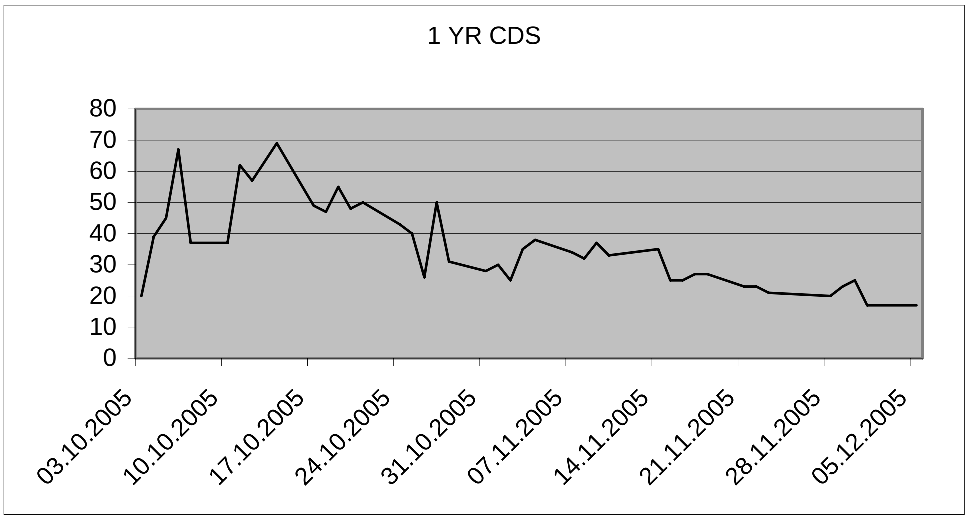
Liquidity: There are few protection sellers for countries that have high probability of default. The most liquid part of CDs market includes countries that are not facing a high risk of default in the short run, but that may be affected if the country defaults.

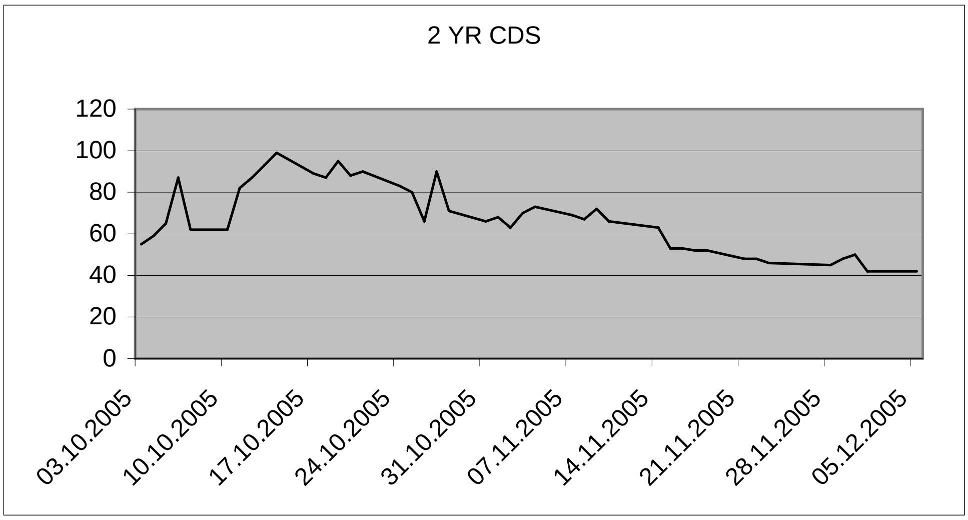
Cheapest-to-deliver option: In a default swap with physical settlement, in case of a credit event, the protection buyer has to deliver obligations in the set of deliverable obligations for the reference credit. Therefore, he will try to maximize his payoff by delivering the cheapest deliverable obligation.

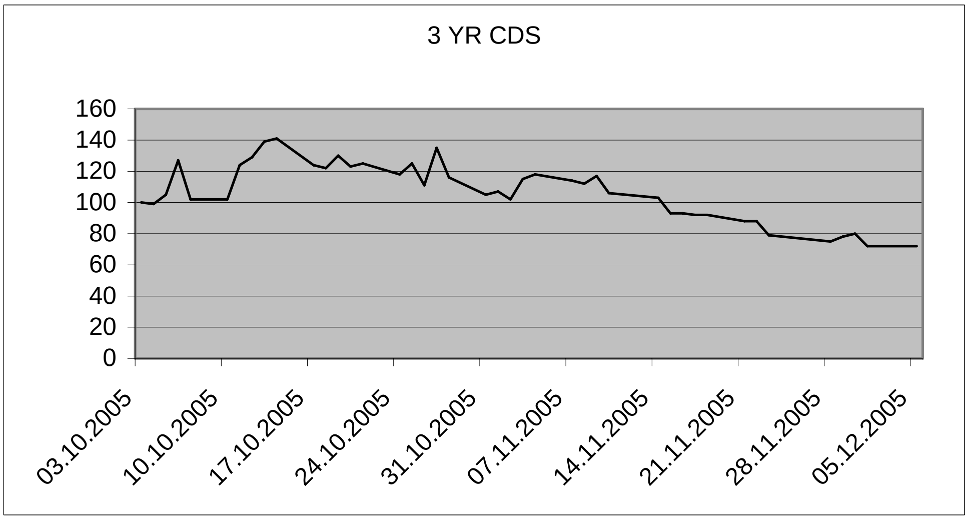
Pay accrual at default: In an event of default, plain vanilla default swap pay accrued interest whereas a holder of bonds typically will not receive accrued interest.

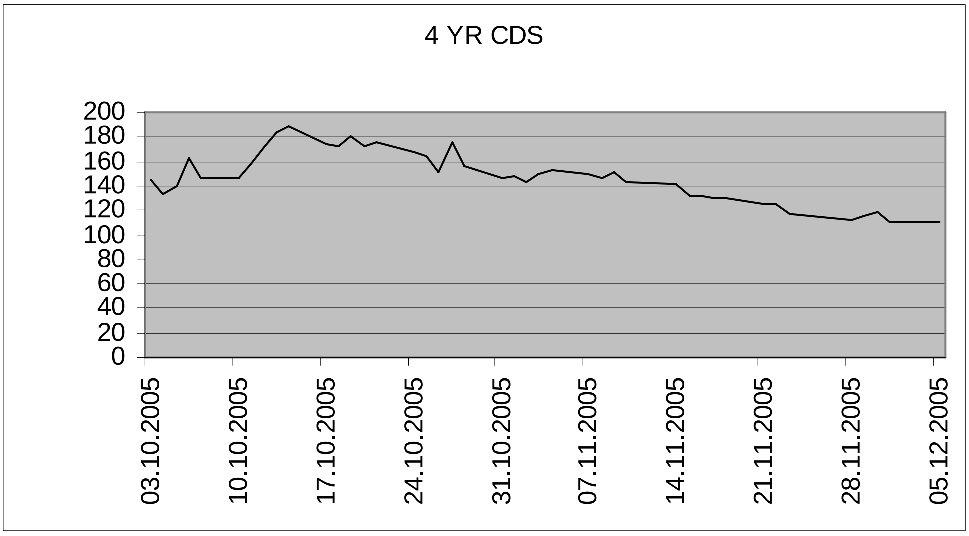
Recent Activity in Credit Default Swaps in Turkey:

The data of Turkish CDSs for the period 03.10.2005-05.12.2005 is studied in this step.The graphs of 1,2,3,4,5 and 10 year Turkish credit default swap rates are given below. After that we give descriptive statistics for these spreads.

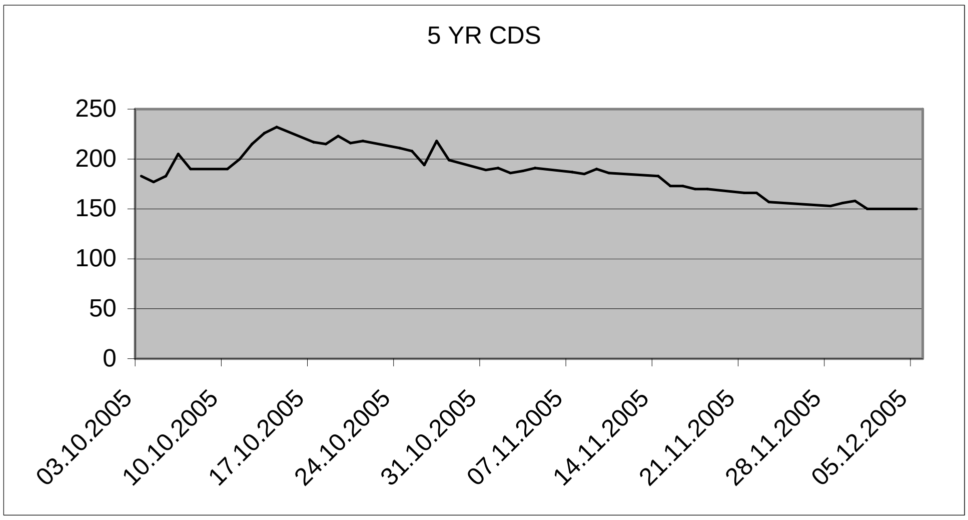

1 YR CDS
80
70
60
50
40
30
20
10
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005


2 YR CDS
120
100
80
60
40
20
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005

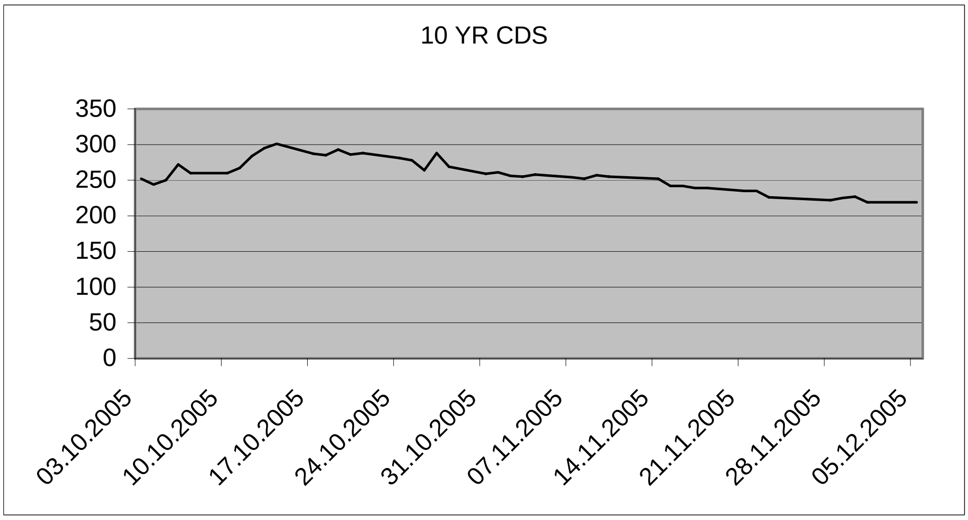

3 YR CDS
160
140
120
100
80
60
40
20
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005



4 YR CDS
200
180
160
140
120
100
80
60
40
20
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005



5 YR CDS
250
200
150
100
50
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005



10 YR CDS
350
300
250
200
150
100
50
0
03.10.2005
10.10.2005
17.10.2005
24.10.2005
31.10.2005
07.11.2005
14.11.2005
21.11.2005
28.11.2005
05.12.2005

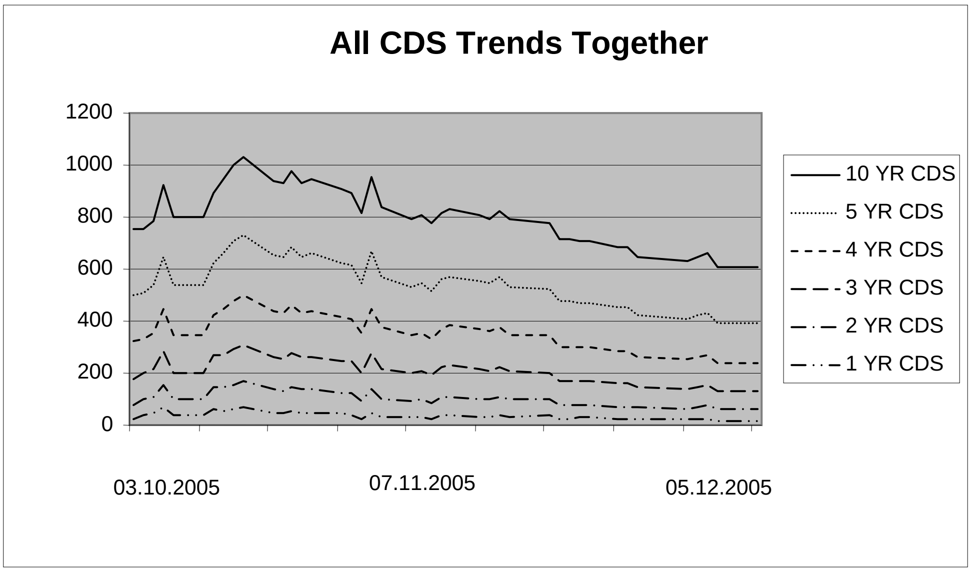


Figure 9. Graphs of 1,2,3,4,5, and 10 year credit default swap data of Turkey for the period 03.10.2005 – 05.12.2005

It is seen in all of the graphs that, CDS spreads have increased in the first two weeks of October and then gradually decreased until the end of the period. The period is not long enough to analyze the effects of economic changes on CDs spreads. Actually there's no need for this as we have already done that in the previous chapter. Spread rates decreased just below the level they were at the beginning of the period.

The descriptive statistics for the data of credit default swaps above and Turkish Eurobond of 2030 maturity are given below.

Table 6: Descriptive Statistics for Turkish CDS and Government Bond data for the period 03.10.2005-05.12.2005

Variable	Descriptive Statistics -1			
	Mean	**Median**	**Mode**	**Frq. of Mode**
1 YR CDS	36,55	34,50	25	4
2 YR CDS	67,76	66,00	multiple	
3 YR CDS	107,10	106,50	102	3
4 YR CDS	147,57	147,00	147	3
5 YR CDS	189,00	188,50	multiple	
10 YR CDS	257,93	256,50	252	3
11,875 GVT BOND	146,16	145,64	no mode	

Variable	Descriptive Statistics – 2				
	Minimum	**Maximum**	**25th Percentile**	**75th Percentile**	**Geometric Mean**
1 YR CDS	17,00	69,00	25,00	47,00	34,07
2 YR CDS	42,00	99,00	53,00	83,00	65,80
3 YR CDS	72,00	141,00	93,00	123,00	105,43
4 YR CDS	110,00	189,00	132,00	165,00	146,06
5 YR CDS	150,00	232,00	173,00	208,00	187,71
10 YR CDS	219,00	301,00	242,00	278,00	256,97
11,875 GVT BOND	142,53	149,87	144,53	148,22	146,14

Variable	Descriptive Statistics – 3				
	Harmonic Mean	**Std. Dev.**	**Variance**	**Avg. Dev.**	**Range**
1 YR CDS	31,80	14,06	197,57	11,36	52,00
2 YR CDS	63,85	16,43	269,99	13,60	57,00
3 YR CDS	103,68	18,65	347,94	15,39	69,00
4 YR CDS	144,53	21,19	448,93	16,79	79,00
5 YR CDS	186,41	22,24	494,49	17,57	82,00
10 YR CDS	256,01	22,50	506,46	17,97	82,00
11,875 GVT BOND	146,13	2,01	4,05	1,74	7,34

Variable	Descriptive Statistics – 4			
	Quartile Range	**Skewness**	**Kurtosis**	**Sum**
1 YR CDS	22,00	0,71	-0,34	1535,00
2 YR CDS	30,00	0,20	-1,11	2846,00
3 YR CDS	30,00	-0,22	-0,76	4498,00
4 YR CDS	33,00	0,00	-0,78	6198,00
5 YR CDS	35,00	0,02	-0,81	7938,00
10 YR CDS	36,00	0,06	-0,84	10833,00
11,875 GVT BOND	3,69	0,25	-1,15	6138,55

Basis Analysis for Turkey

In methodology section we have concluded that ds = s – f where s is the spread over Libor and of the government bond and f is the difference between the Libor rate and the repo rate. For liquidity aspects we use the data for 10 year term CDS for Turkey. In the absence of any market imperfections, the actual price of the default swap and the price of the synthetic default swap should be equal. The figure below presents the difference between the actual default swap and the synthetic 10 year default swap over the period 03.12.2005-05.12.2005

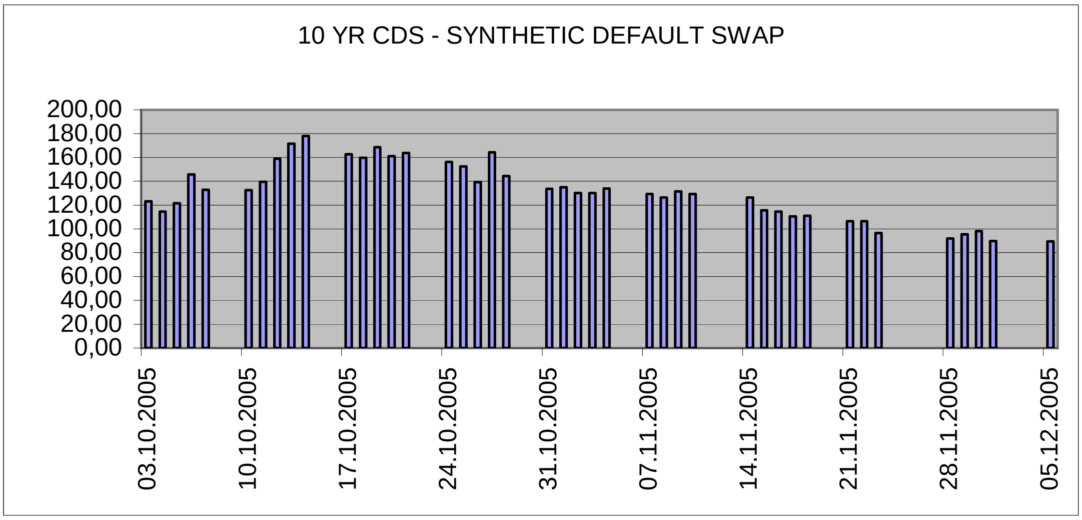


Figure 10: Actual CDS vs. Synthetic Default Swap

On the average, the actual default swap is trading 131 bps above the synthetic default swap created by shorting the Turkish Government Eurobond. This difference can be explained by, the lack of liquidity in the default swap market and the value of the embedded delivery option. It is also implicitly reflects the repo market risks. Short position in default swaps are usually covered by short position in cash via the repo market.

To conclude this section we can say that Turkish credit default swaps are overpriced. In the introduction section we have mentioned that most of the researches about this subject have concluded that credit default swaps are overpriced in the emerging countries.

VII.2. DEFAULT PROBABILITY TERM STRUCTURE of TURKEY

In this part we will again use a methodology similar to the one used by Ranciere (2001). With estimated values of recovery value of underlying bonds we will try to derive term structure of default probability of Turkey. The formulation of the methodology is given in below.

Let's define,

DS t,t' : Default Spread between t and t'

Rt,t' : Risk Free Rate between t and t'.

Pst : Default Probability between t and t+6 months given that there is no default before t

Pt : Default Probability between t and t+1 given that there is no default default before t

St : Survival Probability of an obligation at time t

Dt : Cumulative Default Probability of an obligation at time t

Ht : Probability of a default between t and t+1

R : Recovery rate.

1: Finding forward default swap spreads

With the help of no arbitrage condition we can write:

$(1+R12+DS12)=(1+R02+DS02)^2 /(1+R01+DS01)$

Using this formula iteratively, we can derive forward default spreads.

Here to derive values DS12, DS23, DS34 and DS45 we will need values of R12, R23, R34 and R45. We will again use no arbitrage condition and will assume that:

$1 + R12 = (1 + R02) / (1 + R01)$, $1 + R23 = (1 + R03) / (1 + R02)$

$1 + R34 = (1 + R04) / (1 + R03)$, $1 + R45 = (1 + R05) / (1 + R04)$

2. Calculating the term structure of conditional default probabilities

We have found forward default rates in the previous step and now, we can simply treat each interval of one year independently. The forward spread then reflects the conditional risk of default for the given period. Recalling that the default premium paid every 6 months covers the expected cost of default for the given 6-month period, we apply the *risk neutral valuation principle* to obtain the conditional 6-month default probability Pst (recall the section about default rates with recovery in Chapter III):

$$(1+ Rtt'/2)=(1 - Pst)*(1+ (Rtt' + DS\ tt')/2)+ Pst *R$$

Knowing that no default over one year is equivalent to no default in any of the two 6-month period, we obtained the annualized probability of default as $Pt=1-(1- Pst)^2$.

Note again that Pt is the probability of a default in year t given that no probability occurs until year t.

3. Survival Probability, Cumulative Default Probability and Default Probabilities by Time

Now we are ready to calculate survival probability, default probability and default probabilities by time interval. The Survival Probability is the probability that the bond won't default between now and a given date. So it is St=(1- P0)(1- P1)...(1-Pt) The Cumulative Default Probability is just the opposite of survival probability and gives the risk that the bond will default between now and a given date. Dt =1- St. Finally we can calculate the probability that a default will happen in a certain year which is: Ht=(1- P0)(1- P1)….(1-Pt-1)*Pt

To enlighten the methodology, we will give the formulations step by step and calculate values for a specific date. At the beginning we have the values R01, R02, R03, R04, R05 and DS01, DS02, DS03, DS04, DS05. Data of 05.12.2006 is given below:

Variable	**Value**
R01	0,04368
R02	0,04466
R03	0,04471
R04	0,04479
R05	0,04499
DS01	0,001700
DS02	0,002098
DS03	0,002394
DS04	0,002739
DS05	0,002982

First we must calculate forward risk free rates. So we get:

$R12 = (1 + 0,04466) / (1 + 0,04468) – 1 = 0,000939$

$R23 = (1 + 0,04471) / (1 + 0,04466) – 1 = 0,000048$

$R34 = (1 + 0,04479) / (1 + 0,04471) – 1 = 0,000077$

$R45 = (1 + 0,04499) / (1 + 0,04479) – 1 = 0,000191$

Using the formulation in step 1 for the following years we get the formulas:

$1+R12+DS12 = (1+R02+DS02)^2 / (1+R01+DS01)$

$1+R23+DS23 = (1+R03+DS03)^3 / (1+R01+DS01)(1+R12+DS12)$

$1+R34+DS34 = (1+R04+DS04)^4 / (1+R01+DS01)(1+R12+DS12)(1+R23+DS23)$

$1+R45+DS45 =$

$(1+R05+DS05)^5/(1+R01+DS01)(1+R12+DS12)(1+R23+DS23)(1+R34+DS34)$

Using the formulas above we calculate the values of DS12, DS23, DS34 and DS45.

DS12 = 0,0472 ; DS23 = 0,0477 ; DS34 = 0,0487 ; DS45 = 0,0496

Now we can go through the next step. Using the formula in the second step we derive $Pst = (DSt,t+1) / (2 + Rt,t+1 + DSt,t+1 – 2R)$ and using this, we get the values of Ps0, Ps1, Ps2, Ps3 and Ps4. We choose the recovery value (R) as 0,25.

$Ps0 = DS01/(2 + R01 + DS01 – 2R) = 0,17/(2+0,0437+0,17-0,5) = 0,0011$

$Ps1 = DS12/(2 + R12 + DS12 – 2R) = 0,72337/(2+0,0442+0,72337-0,5) = 0,0305$

$Ps2 = DS23/(2 + R23 + DS23 – 2R) = 1,51712/(2+0,0447+1,51712-0,5) = 0,0309$

$Ps3 = DS34/(2 + R34 + DS34 – 2R) = 2,80577/(2+0,0448+2,80577-0,5) = 0,0315$

$Ps4 = DS34/(2 + R34 + DS34 – 2R) = 4,00046/(2+0,0449+4,00046-0,5) = 0,0320$

Next we will find the values P0, P1, P2, P3 and P4.

$P0 = 1 – (1 – Ps0)^2 = 1 - (1 - 0,0011)^2 = 0,0022$

$P1 = 1 – (1 – Ps1)^2 = 1 - (1 - 0,0305)^2 = 0,0600$

$P2 = 1 – (1 – Ps2)^2 = 1 - (1 - 0,0309)^2 = 0,0607$

$P3 = 1 – (1 – Ps3)^2 = 1 - (1 - 0,0315)^2 = 0,0619$

$P4 = 1 – (1 – Ps4)^2 = 1 - (1 - 0,0320)^2 = 0,0629$

Now we are ready to calculate survival probabilities.

$S0 = (1-P0) = 1-0,0022 = 0,9978$

$S1 = (1-P0)(1-P1) = (1-0,0022)(1-0,0600) = 0,93789$

$S2 = (1-P0)(1-P1)(1-P2) = (1-0,0022)(1-0,0600) (1-0,0607) = 0,88091$

$S3 = (1-P0)(1-P1)(1-P2)(1-P3)=(1-0,0022)(1-0,0600)(1-0,0607)(1-0,0619) = 0,82636$

$S4 = (1-P0)(1-P1)(1-P2)(1-P3)(1-P4)$

$S4 = (1-0,0022)(1-0,0600) (1-0,0607) (1-0,0619) (1-0,0629) = 0,77435$

And, cumulative default probabilities are:

$D0 = 1 – S0 = 1-0,9978 = 0,0022$; $D1 = 1 – S1 = 1-0,93789 = 0,06211$

$D2 = 1 – S2 = 1-0,88091 = 0,11909$; $D3 = 1 – S3 = 1-0,82636 = 0,17364$

$D4 = 1 – S4 = 1-0,77435 = 0,22565$

Finally we will calculate the probability of a default occurring precisely in any one year time interval:

$H0 = P0 = 0,0022$

$H1 = (1-P0)P1 = (1-0,0022)*0,0600 = 0,0599$

H2 = (1-P0)(1-P1)P2 = (1-0,0022)(1-0,0600)*0,0607 = 0,0570

H3 = (1-P0)(1-P1)(1-P2)P3 = (1-0,0022)(1-0,0600)(1-0,0607)*0,0619 = 0,0546

H4 = (1-P0)(1-P1)(1-P2)(1-P3)P4

H4 = (1-0,0022)(1-0,0600)(1-0,0607) (1-0,0619)*0,0629=0,0520

The results are given below:

Variable	Value
P0	0,22
P1	6,00
P2	6,07
P3	6,19
P4	6,29
S0	99,78
S1	93,79
S2	88,09
S3	82,64
S4	77,44

Variable	Value
D0	0,22
D1	6,21
D2	11,91
D3	17,36
D4	22,56
H0	0,22
H1	5,99
H2	5,70
H3	5,46
H4	5,20

In the study by Ranciere (2001), the probability calculations for Argentina and Brasil are made for an exact date. Above, we have done similar calculations for Turkey data of 05.12.2005. But, taking just one date into account may not give accurate results. So we have widened the study to an extent. We took into account a time interval of two months. In our study we have done all the calculations for recovery values of 0,25 and 0,5 for the term of 03.10.2005-05.12.2005. The average values of survival probabilities, cumulative default probabilities and probability of a default occurring precisely in any one year time interval are given below.

Variable	R=0,25	Std. Dev.	R=0,5	Std. Dev.
P0	0,47	0,18	0,69	0,27
P1	5,91	0,16	8,67	0,23
P2	6,06	0,15	8,88	0,21
P3	6,14	0,14	9,01	0,20
P4	6,10	0,13	8,95	0,18
S0	99,53	0,18	99,30	0,27
S1	93,64	0,18	90,69	0,26
S2	87,96	0,27	82,63	0,37
S3	82,56	0,36	75,18	0,48
S4	77,51	0,41	68,45	0,53
D0	0,47	0,18	0,70	0,27
D1	6,36	0,18	9,31	0,26
D2	12,04	0,27	17,37	0,37
D3	17,44	0,36	24,82	0,48
D4	22,49	0,41	31,55	0,53
H0	0,47	0,18	0,70	0,27
H1	5,89	0,16	8,61	0,23
H2	5,68	0,14	8,06	0,18
H3	5,41	0,11	7,45	0,14
H4	5,04	0,09	6,73	0,11

The results day by day are given in the appendix. And the graphs of our results are given below:

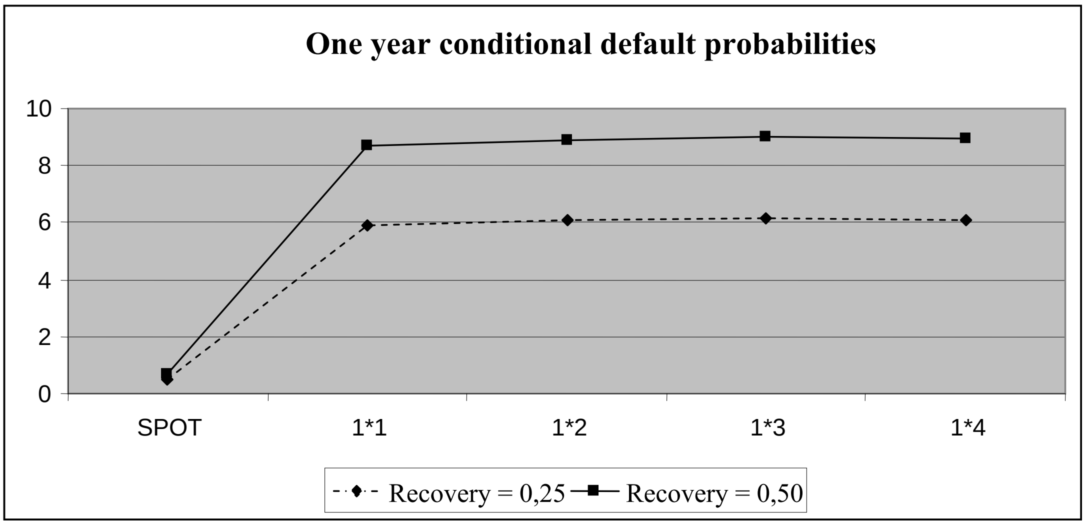


Figure 11: Conditional Default Probabilities For Turkey

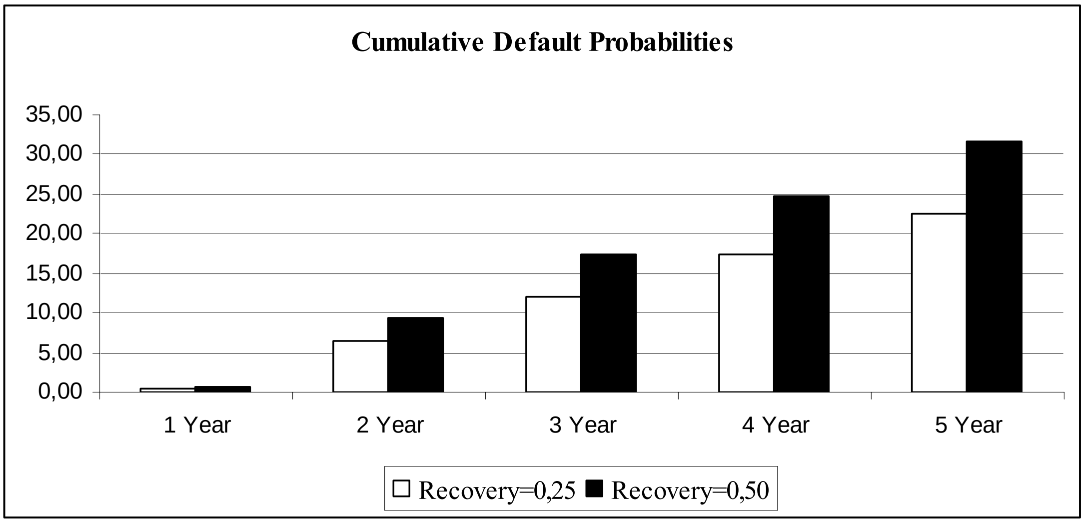


Figure 12: Cumulative Default Probabilities for Turkey

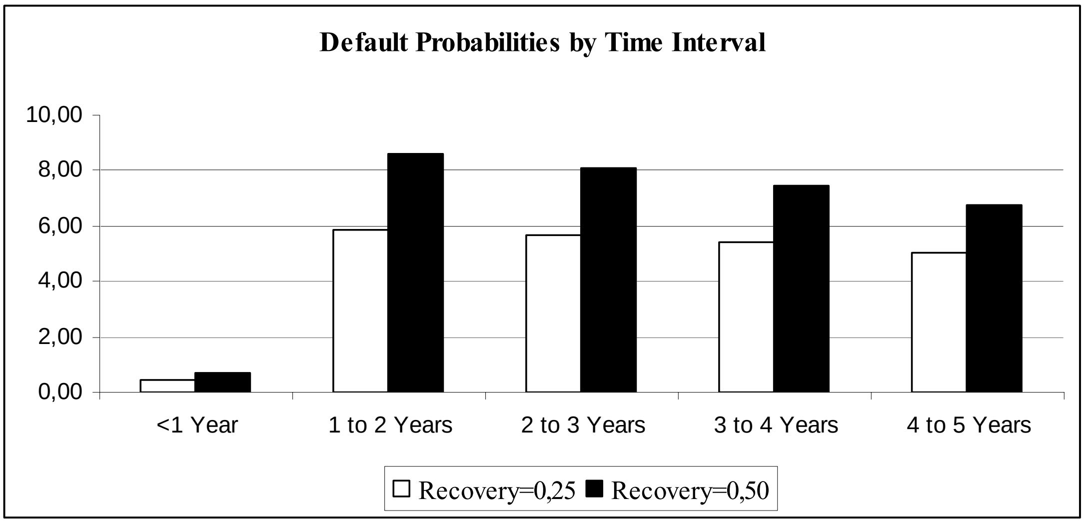


Figure 13: Default Probabilities by Time Interval for Turkey

Looking at the figures above, we can make some forecasts about probability of default of Turkey in the next 5 years. First of all probability of default of Turkey in the first year is very low. The conditional probability increases very sharply in the second year and stays almost horizontal after that.

When we look at cumulative default probabilities, default risk of Turkey increases almost uniformly for the next five years. Probability of default in the first year is less than 1% for both recovery values. As it increases year by year it reaches to values of 22,49% and 31,55% for the fifth year for two recovery values respectively.

According to the last figure, a default will most probably during the next year (5,89% for R=0,25 and 8,61% for for R=0,50). If we talk about probabilities for recovery value of 0,25; Turkey will default in the first year with the probability of 0,47%. For each following year, Turkey will default with probabilities ranging between 5% and 6%. With recovery value of 0,5 default probabilities are more than those with recovery value of 0,25. Turkey will default with the probability of 0,70% in the first year. And in the following years probability of default occurring precisely in that year, ranges approximately between 7% and 9%.

Looking at the survival probabilities we can say that survival probability is at its maximum at the beginning. This probability decreases almost uniformly for the next years. For the last year survival probability is 77,51% and 68,45% for recovery values of 0,25 and 0,5 respectively.

In the study by Ranciere (2001) cumulative default probability of Argentina on 03.08.2001 is calculated as 80%. As it is known period that, 03.08.2001 belongs, was a period of economic downturn both for Turkey and Argentina. To give an idea it may be useful to tell that 10 year CDS spread of Turkey was 11,025% on 03.08.2001 and 2,19% on 05.12.2005. It can be said that on 03.08.2001, default probability of Turkey was much greater than that on 05.12.2005.

CHAPTER VIII

CONCLUSION

Usage of credit derivatives among financial institutions for risk management purposes is increasing sharply in last years. Especially with the standardization of the documentation of credit derivatives, this increase will continue in an accelerating way.

On the other hand, credit derivatives are new to Turkish institutions. This is not very surprising as the term “derivatives” is not very old for Turkish finance environment. But it can be said that after the economic crisis of 2001 in Turkey, it is seen that traditional way of credit risk management doesn’t work efficiently in bad times. But that does not mean Turkish Banks are using credit derivatives for risk management purposes actively at present. Actually banks and financial institutions in Turkey prefer waiting for now. Usage of credit derivatives in Turkey is almost negligible when compared with other markets. But we believe, as in the other markets Turkish institutions will also use credit derivatives more actively in the near future.

In our study we preferred to study credit default swaps because it is the most preferred kind of credit derivative, especially in emerging markets.

We first tried to state the current situation of usage of credit default swaps. As mentioned above, we have seen that Turkish institutions prefer to wait for the usage of credit default swaps. For now, some banks are taking role as protection sellers to foreign institutions that have Turkish government Eurobonds in their portfolio.

In the quantitative part of our study, we first analyzed credit default swap data of Turkey for the last four years. We have concluded that, the credit default swap data of Turkey are strictly related to underlying Turkish government bonds, not surprisingly. Another conclusion of first part of our study is, credit default swap data are strongly related to economic conjuncture of Turkey. Credit Default Swap spreads increase sharply in terms of crisis and vice versa.

In the next step, we have calculated spreads for synthetic default swaps and compared this with actual CDS data. It is seen that actual credit default swap spreads are higher than calculated spreads of synthetic default swaps. This situation can be explained by lack of liquidity and the value of the embedded delivery option. In another way we can say that, price of hedging risk for Turkish bonds is expensive.

With these analyses in hand, we made an analysis of term structure of default probability of Turkey. According to our analysis we have seen that default probability of Turkey in the next four years is 22,49% and 31,55% for different recovery values. It can be said that our anaylsis has a shortcoming that credit default spread market of Turkey has a low liquidity and credit default swaps are overpriced as we mentioned previously. It may be true to some extend but we think our calculations are still reasonable.

We believe that, with the increase of use of credit default swaps, the difference between actual default swaps and synthetic default spreads will decrease and calculation of term structure of probability of default will give more accurate results.

So, in the future studies for Turkish credit default swaps will increase and will give more accurate and healthy results.

Finally, in our view, default probabilities of Turkey that are calculated in our study show that Turkey is a stable market and suitable for foreign investment in the following years. Of course, it is not possible to say that, an unexpected “artificial” economic crisis won’t happen or foreign investments won’t fly away unexpectedly.

REFERENCES

Aggrawal S. K. (2000). Credit Derivatives Move Beyond Plain Vanilla. The Stern Journal (Spring 2000).

Altman E.; Resti A. & Sironi A. (2002). The Link Between Default and Recovery Rates: Effects on the Procyclicality of Regulatory Capital Ratios. BIS.

Aunon-Nerin D.; Cossin D.; Hricko T. & Huang Z. (2002). Exploring for the Determinants of Credit Risk in Credit Default Swap Transaction Data: Is Fixed Income Markets' Information Sufficient to Evaulate Credit Risk?. International Center for Financial Asset Management and Engineering.

Blanco R.; Brennan S. & Marsh I. W. (2003). An Empirical Analysis of the Dynamic Relationship Between Investment Grade Bonds and Credit Default Swaps. Banco de Espana.

Blanco R.; Brennan S. & Marsh I. W. (2003). An Empirical Analysis of the Dynamic Relationship Between Investment Grade Bonds and Credit Default Swaps. Banco de Espana.

Bomfim A. N. (2001). Understanding Credit Derivtives and Their Potential to Synthesize Riskless Assets. Federal Reserve Board.

Brigo D. & Tarenghi M. (2004). Credit Default Swap Calibration and Equity Swap Valuation under Counterparty Risk with a Tractable Structural Model. Banca IMI.

Broll U.; Schmayer G. & Welzel P. (2003). Managing Credit Risk with Credit and Macro Derivatives. Institut für Volkswirtschaftslehre.

Carozzi A. M. (2001). Credit Derivatives. Libera Universita Internazionale.

Chan-Lau J. A. (2003). Anticipating Credit Events Using Credit Default Swaps, with an Application to Sovereign Debt Crises. IMF Working Paper.

Garcia J.; Ginderen H. & Garcia R. (2001). Present Valuing Credit Default Swaps: a Practitioner View.

Grossman R.; Verde M.; Mancuso P. & Olson K. (2003). Credit Derivatives: A Case of Mixed Signals. Fitch Ratings.

Houweling P. & Vorst T. (2002). An Empirical Comparison of Default Swap Pricing Models.

Hull J. & White A. (2000). Valuing Credit Default Swaps I: No Counterparty Default Risk. Rotman School of Management, University of Toronto.

Hull J.; Predescu M. & White A. (2004). The Relationship Between Credit Default Swap Spreads, Bond Yields, And Credit Rating Announcements.

Hull J. (2004). Options, Futures and Other Derivatives. Parentice Hall.

Ito T. & Harada K. (2003). Market Evaluations of Banking Fragility in Japan: Japan Premium, Stock Prices, and Credit Derivatives. National Bureau of Economic Research.

Joro T. & Na P. (2003). A Simulation Based Credit Default Swap Pricing Approach Under Jump Diffusion. University of Alberta School of Business, Bayerische Landesbank.

Lee P. B.; Wise M. B. & Bhansali V. (2003). Debt Subordination and the Pricing of Credit Default Swaps. California Institute of Technology.

Longstaff F. A.; Mithal S. & Neis E. (2003). The Credit Default Swap Market: Is Credit Protection Priced Correctly.

Longstaff F. A.; Mithal S. & Neis E. (2004). Corporate Yield Spreads: Default Risk or Liquidity? New Evidence From the Credit Default Swap Market. National Bureau of Economic Research.

Marsh I. W. (2001). What Central Banks Can Learn About Default Risk From Credit Markets. Bank of England.

Merritt R.; Linnell I.; Grossmann R.; Grabelsky G.; Cottrell M. & Rosenthal E. (2003). Global Credit Derivatives: A Qualified Success. Fitch Ratings.

Merritt R.; Linnell I.; Grossmann R.; Cottrell M. & Rosenthal E. (2003). Global Credit Derivatives: Risk Management or Risk. Fitch Ratings.

Merritt R.; Mancuso P.; Batterman J. & Linnell I. (2004). CDS Market Liquidty: Show Me the Money. Fitch Ratings.

Merritt R. & Linnell I. (2004). Liquidty in the Credit Default Swap Market: Too Little Too Late? Fitch Ratings.

Micu M.; Remolona E. M. & Wooldridge P. D. (2004). The Price Impact of Rating Announcements: Evidence From the Credit Default Swap Market. BIS.

Packer F. & Suthiphongchai C. (2003). Sovereign Credit Default Swaps. BIS.

Ranciere R. G. (2001). Credit Derivatives in Emerging Markets. IMF Working Paper.

Schönbucher P. J. (1999). A Tree Implementation of a Credit Spread Model for Credit Derivatives. Bonn University.

Schönbucher P. J. (2003). A Note on Survival Measures and The Pricing of Options on Credit Default Swaps. ETH Zurich.

Singh M. (2003). Are Credit Default Swap Spreads High in Emerging Markets? An Alternative Methodology for Proxying Recovery Value. IMF Working Paper.

Skora R. K. (1998). Pricing Credit Derivatives. Skora & Company Inc.

Skora R. K. (1998). The Credit Default Swap. Skora & Company Inc.

Usman Ali P. (2001). New Applications in Credit Derivatives. University of Queenland.

Whetten M.; Adelson M. & Bemmelen M. (2004). Credit Default Swap Primer. Nomura Securities International Inc.

Zhang F. X. (2003). What Did the Credit Market Expect of Argentina Default? Evidence from Default Swap Data. Federal Reserve Board.

Zhu H. (2004). An Empirical Comparison of Credit Spreads Between The Bond Market And The Credit Default Swap Market. BIS.

APPENDIX I: EXAMPLES OF CREDIT DEFAULT SWAP CONTRACTS IN TURKEY

CONTRACT 1.

	CREDIT DEFAULT SWAP TRANSACTION **INDICATIVE TERMS & CONDITIONS**
Definitions	The definitions and provisions contained in the 2000 ISDA Definitions (the "**2000 Definitions**"), as published by the International Swaps and Derivatives Association Inc.,("**ISDA**") and the definitions contained in the 2003 ISDA Credit Derivatives Definitions as supplemented by the May 2003 Supplement to the 2003 ISDA Credit Derivatives Definitions (together the "**Credit Derivatives Definitions**") as published by ISDA are incorporated into this Termsheet. In the event of any inconsistency between the 2000 Definitions and the Credit Derivatives Definitions, the Credit Derivatives Definitions shall prevail. In the event of any inconsistency between the Credit Derivatives Definitions and provisions in this Termsheet, the provisions of this Termsheet will govern.
Parties	M International Dbank ("**Counterparty**")
Transaction type	A Credit Default Swap Transaction (the "**Transaction**"). For the avoidance of doubt, the Credit Default Swap shall form one Transaction for the purposes of the ISDA Master Agreement between the parties.
Trade Date	August 9, 2004
Effective Date	August 13, 2004
Termination Date	The earliest of (i) **May 15, 2008 ("Scheduled Termination Date");** (ii) the date on which the TRS Reference Asset ceases to exist or are redeemed in full; (iii) the date on which an event of default (as described in the terms and conditions of the TRS Reference Asset) occurs; (iv) the date on which an Event Determination Date in respect of the Credit Default Swap has been determined and (v) the Early Termination Date.
	CREDIT DEFAULT SWAP
General Terms	
Buyer:	M International
Seller:	Dbank
Trade Date:	August 9, 2004
Effective Date:	August 13, 2004
Scheduled Termination Date:	May 14, 2008
Calculation Agent:	M International
Calculation Agent City:	London
Business Days:	New York, London and Istanbul
Business Day Convention:	Following (which, subject to Sections 1.4 and 1.6 of the Credit Derivatives Definitions, shall apply to any date referred to in this Term Sheet that falls on a day that is not a Business Day).
Fixed Rate Payer & Floating Rate Payer Calculation Amount:	USD 20,000,000
Credit Details:	
Reference Entity:	Republic of Turkey
Reference	The obligation identified as follows:

Obligation:		
Primary Obligor:	Republic of Turkey	
Maturity:	January 15, 2030	
Coupon:	11.875%	
CUSIP/ISIN:	US900123AL40	
Original Issue Amount:	USD 1,500,000,000	
Reference Price:	100.00%	
All Guarantees	Applicable	
<u>Buyer ("Fixed Rate Payer") Payments:</u>		
Fixed Rate:	**3.45%**	
Day Count Fraction:	30/360	
Payment Dates:	Semi-Annually in arrears	
<u>Seller ("Floating Rate Payer") Payments:</u>		
Conditions to Settlement:	Credit Event Notice Notifying Party: Buyer or Seller	
	Notice of Physical Settlement	
	Notice of Publicly Available Information Applicable	
Credit Events:	Failure to Pay Payment Requirement: $ 1 million Grace Period Extension Applicable Grace Period: 30 calendar days Obligation Acceleration Restructuring Default Requirement: $10 million Multiple Holder Obligation : Not Applicable Repudiation/Moratorium	
Obligations:	Category:	Characteristics:
	Bond	Not Subordinated Not Domestic Law Not Domestic Currency Not Domestic Issuance
Settlement Terms:		
Settlement Method:	Physical Settlement	
Physical Settlement Period:	The longest of the number of Business Days for settlement in accordance with then current market practice of such Deliverable Obligation, as determined by the Calculation Agent, after consultation with the parties (in accordance with Section 8.6 of the Credit Derivatives Definitions).	
Deliverable Obligations:	Exclude Accrued Interest	
Deliverable Obligation Category:	Bond	
Deliverable Obligation Characteristics:	Not Subordinated, Standard Specified Currencies, Not Domestic Law, Not Domestic Issuance, Not Contingent, Not Bearer, Transferable	
Escrow:	Applicable	
OTHER TERMS		
Documentation	ISDA Master Agreement and Confirmation using the 2000 Definitions in respect of the Credit Derivative Definitions in respect of the Credit Default Swap, to be provided by M International. Note that this Term Sheet shall be superseded upon the execution of a Confirmation between the parties. M International and Counterparty shall also execute a Credit Support Agreement to cover the collateral arrangements related to this Transaction.	

Governing Law	Unless otherwise provided in the Agreement, this Term Sheet will be governed by and construed in accordance with the laws of England and Wales.
Key Risks	The Counterparty is exposed to M International for performance of its obligations under the Transaction. In addition, the Counterparty is also exposed to: Under the terms of the **Credit Default Swap**, the risk on the Reference Entity and any change in the market value of the Credit Default Swap
Other Terms:	Each party represents to the other party that it is acting for its own account, and has made its own independent decisions to enter into this Transaction and as to whether this Transaction is appropriate or proper for it based on its own judgment and upon advice from such legal, tax, regulatory, accounting and/or other advisors as it has deemed necessary. It is not relying on any communication (written or oral) of the other party as investment advice or as a recommendation to enter into this Transaction, it being understood that information and explanations related to the terms and conditions of this Transaction shall not be considered investment advice or a recommendation to enter into this Transaction. No communication (written or oral) received from the other party shall be deemed to be an assurance or guarantee as to the expected results of this Transaction.
	Collateral terms in respect of the Transaction
SUMMARY OF COLLATERAL TERMS	The terms outlined herein will form part of the terms of the Credit Support Agreement executed between the Parties in respect of the Transaction.
Minimum Transfer Amount	USD 250,000
Business Days	London, New York and Istanbul
MTM Threshold Amount	USD 16,000,000
Collateral Arrangements	"Eligible Collateral" means cash. "Eligible Currency" means United States dollars "**Additional Cash Collateral**" means amounts, determined pursuant to the provisions below, in United States dollars. If the MTM Value falls below the MTM Threshold Amount the Counterparty is required to post Additional Cash Collateral to M ınternational in an amount equal to the difference between the USD 18,000,000 and MTM Value, provided, however, that on the first occasion on which such Additional Cash Collateral is required to be posted, such difference must exceed the Minimum Transfer Amount. On each subsequent Business Day, if the MTM Value plus the aggregate of all Additional Cash Collateral posted (the "Aggregate MTM Value") falls below USD 18,000,000 the Counterparty is required to post Additional Cash Collateral in an amount equal to the difference between USD 18,000,000 and the Aggregate MTM Value provided, that such difference exceeds the Minimum Transfer Amount. Any requests for Additional Cash Collateral will be made by way of written notice from M International to the Counterparty prior to 3 p.m. local time in London on a given Business Day (the "Collateral Call Date"), and the Counterparty shall be required to post the Additional Cash Collateral amount on the Business Day following the Collateral Call Date. M International shall confirm with the Counterparty that any transmitted notice has been received. If the request for Additional Cash Collateral is made after 3 p.m. London time on any Business Day, then such notice shall be deemed to have been given on the next Business Day.
Collateral Arrangements (continued)	If the MTM Value exceeds the MTM Threshold Amount, M International shall, within 1 Business Days of receipt of a notice from the Counterparty requesting the return of the Additional Cash Collateral, return to the Counterparty any amounts of Additional Cash Collateral posted in excess of the Minimum Threshold Amount provided, however, that the amount to be returned must be in excess of the Minimum Transfer Amount. For the avoidance of doubt, M International shall only be under an obligation to return amounts of Additional Cash Collateral to the extent that they have been posted pursuant to these terms, and in no circumstances shall be required to refund any amounts if the MTM Value exceeds the MTM Threshold Amount if the Counterparty has not posted any Additional Cash Collateral.

Settlement of Collateral:	Failure of the Counterparty to deliver an Additional Cash Collateral amount in accordance with the terms described above may, provided that the Counterparty has not rectified such failure, result in the termination of the Credit Default Swap Transaction at the discretion of M International on the second Business Day following the Collateral Call Date. If M International exercises its discretion hereunder, the Credit Default Swap Transaction will terminate and the unwind price of the Credit Default Swap Transaction will be determined in the sole discretion of the Calculation Agent acting in good faith and commercially reasonable manner.
Return on Collateral	The Additional Cash Collateral posted to M International shall accrue interest at the overnight Fed Funds interest rate.
Documentation	The terms and conditions outlined herein do not constitute the final legal terms and conditions of the Credit Default Swap Transaction and related collateral arrangement entered into by the parties. The final terms shall be in the form of a Credit Default Swap confirmation (ISDA format) incorporating Transaction specific collateral terms.

CONTRACT 2.

A. Definitions	This Confirmation evidences a complete and binding agreement between you and us as to the terms of the Transaction to which this Confirmation relates. In addition, you and we agree to use all reasonable efforts promptly to negotiate, execute and deliver an agreement in the form of an ISDA Master Agreement, with such modifications as you and we will agree in good faith. Upon the execution by you and us of such an agreement, this Confirmation shall supplement, form part of and be subject to that agreement. All provisions contained in or incorporated by reference in that agreement upon its execution will govern this Confirmation except as expressly modified below. Until we execute and deliver that agreement, this Confirmation (together with all other documents referring to an ISDA Master Agreement (each, a "Confirmation") confirming transactions (each, a "Transaction") entered into between us (notwithstanding anything to the contrary in a Confirmation), shall supplement, form a part of, and be subject to, an agreement in the form of the 1992 ISDA Master Agreement (Multicurrency – Cross Border) as if we had executed an agreement in such form (but without any Schedule except for the election of English Law as the governing law, U.S. dollars as the Termination Currency and including as Section 6(f) of such agreement the provisions of Section V(A) of ISDA's User's Guide to the 1992 Master Agreements) on the Trade Date of the this Transaction. In the event of any inconsistency between the provisions of that agreement and this Confirmation, this Confirmation will prevail for the purpose of this Transaction. The terms of the Transaction to which this Confirmation relates are as follows:
B. Credit Default Swap	
	The definitions and provisions contained in the 2003 ISDA Credit Derivatives Definitions as supplemented by the May Supplement to the 2003 Credit Derivatives Definitions (together, the "2003 Definitions") (together, the "Credit Derivatives Definitions") each as published by the International Swaps and Derivatives Association, Inc., are incorporated into Section B only of this Transaction. In the event of any inconsistency between the Credit Derivatives Definitions and this Confirmation, this Confirmation will govern.
1. General Terms:	
Trade Date:	October 6, 2004
Effective Date:	October 13, 2004
Scheduled Termination Date:	October 13, 2009
Floating Rate Payer:	DBank (the "Seller")
Fixed Rate Payer:	BBank (the "Buyer")
Calculation Agent:	Buyer
Calculation Agent City:	New York
Business Day:	London, New York and Istanbul

Business Day Convention:	Following (which, subject to Sections 1.4 and 1.6 of the Credit Derivatives Definitions, shall apply to any date referred to in this Confirmation that falls on a day that is not a Business Day)
Reference Entity:	Republic of Turkey
Reference Obligation(s):	The obligation identified as follows: Primary Obligor: Republic of Turkey Guarantor: None Maturity: January 15, 2030 Coupon: 11.8750 % CUSIP/ISIN: 900123AL4
All Guarantees:	Applicable
Reference Price:	100%
2. Fixed Payments:	
Fixed Rate Payer Calculation Payment:	USD 15,000,000
Fixed Rate Payer Payment Dates:	The 13th of October and April in each year, commencing on April 13, 2005
Fixed Rate:	6.00% per annum
Fixed Rate Day Count Fraction:	Actual/360
3. Floating Payment:	
Floating Rate Payer Calculation Amount:	USD 30,000,000
Conditions to Settlement:	Credit Event Notice
	Notifying Party: Buyer or Seller
	Notice of Physical Settlement
	Notice of Publicly Available Information Applicable
	Specified Number: Two
Credit Events:	The following Credit Events shall apply to this Transaction:
	Repudiation/Moratorium
	Obligation Acceleration
	Failure to Pay
	Grace Period Extension: Applicable
	Payment Requirement: USD 1,000,000 or its equivalent in the relevant Obligation Currency as of the occurrence of the relevant Failure to Pay
	Restructuring
	Restructuring Maturity Limitation and Fully Transferable Obligation: Not Applicable
	Multiple Holder Obligation: Not Applicable
	Default Requirement: USD 10,000,000 or its equivalent in the relevant Obligation Currency as of the occurrence of the relevant Credit Event
Obligation(s):	
Obligation Category:	Bond
Obligation Characteristics:	Not Subordinated
	Not Domestic Currency
	Not Domestic Issuance
	Not Domestic Law
Excluded Obligations:	None
4. Settlement Terms:	
Settlement Method	Physical Settlement
Terms Relating to Physical Settlement:	
Physical Settlement Period:	As defined in Section 8.6 of the Credit Derivatives Definitions, but in no event longer then thirty (30) Business Days.
Deliverable Obligations:	Exclude Accrued Interest
Deliverable Obligation Category:	Bond
Deliverable Obligation	Not Subordinated, Specified Currency: Standard Specified Currencies, Not Contingent, Not Domestic Issuance, Not Domestic Law, Not Contingent, Not

Characteristics:	Bearer, Transferable
Excluded Deliverable Obligations:	None
Escrow:	Applicable
5. Other Terms	
Deposit Terms:	Seller will deposit with the Buyer the Fixed Rate Payer Calculation Amount on the Effective Date.
	The Buyer will pay USD 6 month LIBOR on the Fixed Rate Payer Calculation Amount to the Seller on the Fixed Rate Payer Payment Dates.
6. Additional Terms	
Accelerated Termination Event:	The occurrence of a Trigger Event.
	The occurrence of an Accelerated Termination Event will be determined by the Calculation Agent in its sole and absolute discretion.
Accelerated Termination Event	If an Event Notice is delivered by the Calculation Agent to each of the parties, the Buyer shall have the right, but not the obligation, (at any time from and including the day on which such Event Notice is delivered and whether or not the relevant Accelerated Termination Event is continuing) by notice to the Seller (the date of such notice being the "Optional Early Termination Notification Date"), designate any Business Day from and including the Optional Early Termination Notification Date as an optional early termination date (the "Optional Early Termination Date") in respect of this Transaction. Upon the designation of an Optional Early Termination Date, or if an Accelerated Termination Event is subsisting on the Scheduled Termination Date, no further payments will be due by either party with respect to this Transaction, except as set out under the Early Termination Settlement provisions herein.
Event Notice:	A notice from the Calculation Agent to the Seller (which will be given orally and followed by notice in writing, including by electronic means in the form of an email or a facsimile specifying the occurrence of an Accelerated Termination Event. The Calculation Agent shall have the right but not the obligation to deliver an Event Notice at any time following the occurrence of an Accelerated Termination Event.
Trigger Event:	A Trigger Event will occur if (i) Bbank gives a notice to the Seller as contemplated by "Notification Period" below, (ii) the relevant Notification Period ends, and (iii) the credit default swap spread of the Reference Obligation to the Scheduled Termination Date is equal to or greater than the then applicable Trigger Event Level.
Trigger Event Level:	A percentage equal to or greater than 9.50% provided however that such percentage shall (as applicable) be (a) increased by 2% for each USD 2,500,000 Additional Deposit Amount (if any) that has been delivered by the Seller to Bbank and that remain on deposit with Bbank; or (b) decreased by 2% for each USD 2,500,000 Additional Deposit Amount that has been returned to the Seller pursuant to Section 7 hereof as determined by the Calculation Agent in its sole and absolute discretion.
Notification Period:	(i) if the Buyer informs the Seller by 11am London time on any London and Istanbul Business Day that the credit default swap spread of the Reference Obligation to the Scheduled Termination Date is equal to or greater than the Trigger Event Level, the Notification Period shall be until the close of business on that day; (ii) if Buyer informs Seller after 11am London time on any London and Istanbul Business Day that the credit default swap spread of the Reference Obligation to the Scheduled Termination Date is equal to or greater the Trigger Event Level, the Notification Period shall be until the close of business on the following Business Day.
7. Additional Deposits	
Additional Deposit Amounts:	On any Business Day prior to the Scheduled Termination Date, the Seller may in its sole and absolute discretion, deliver to the Buyer additional cash amounts equal to USD 2,500,000 ("Additional Deposit Amount"). In the event that the Seller has posted Additional Deposit Amounts and the credit default swap spread of the Reference Obligation to the Scheduled Termination date is less than the previous Trigger Event Level, Seller may request that Buyer return an appropriate portion of the Additional Deposit Amounts to Seller, as determined by the Calculation Agent in its sole discretion.
8. Early Termination	

Early Termination Settlement:	If this Transaction is terminated prior to the Scheduled Termination Date due to the occurrence of an Accelerated Termination Event the CDS Early Termination Amount shall mean an amount owed by the Buyer equal to: The Fixed Rate Payer Calculation Amount; plus Any Additional Deposit Amounts; minus The amount that the Buyer would have to pay to a counterparty to unwind a USD 30,000,000 5 year credit default swap as shown in Annex A (as determined by the Calculation Agent in its sole and absolute discretion); minus Any additional unwind costs (as determined by the Calculation Agent in its sole and absolute discretion) which may include breakage costs on the LIBOR or other financing rate or any other internal unwind costs. Each component of the CDS Early Termination Amount shall be determined by the Calculation Agent in its sole and absolute discretion.
	Payments on Early Termination To the extent that the CDS Early Termination Amount is positive, the Buyer shall pay such amount to the Seller. Amount shall be reduced by the absolute value of the negative CDS Early Termination Amount.
9. Other Terms:	
	Turkey DBank AS shall have the right to terminate Section A or Section B of this Transaction, in each case in whole or in part, at any time prior to the Scheduled Termination Date, at a price determined by the Calculation Agent in its sole and absolute discretion, provided, no Accelerated Termination Event under Section A or Section B hereunder has occurred.
	Annex A
1. General Terms:	
Trade Date:	October 6th 2004
Effective Date:	October 13th 2004
Scheduled Termination Date:	October 13th 2009
Floating Rate Payer:	BBank Plc ("Seller")
Fixed Rate Payer:	Market Participants
Calculation Agent:	Seller
Calculation Agent City:	LONDON
Business Days:	New York and London
Business Day Convention:	Following. (which subject to Sections 1.4 and 1.6 of the Credit Derivatives Definitions, shall apply to any date referred to in this Confirmation that falls on a day that is not a Business Day)
Reference Entity:	REPUBLIC OF TURKEY
	The obligation identified as follows: Primary Obligor: REPUBLIC OF TURKEY Maturity: Jan 15, 2030 Coupon: 11.8750% CUSIP/ISIN: 900123AL4
All Guarantees:	Applicable
Reference Price:	100%
2. Fixed Payments:	
Fixed Rate Payer Calculation Amount:	USD 30,000,000
Fixed Rate Payer Payment Dates:	13th of each October and April commencing on April 13th 2005
Fixed Rate:	3.00% per annum
Fixed Rate Day Count Fraction:	Actual/360
3. Floating Payment:	
Floating Rate Payer Calculation Amount:	USD 30,000,000

Conditions to Settlement:	Credit Event Notice Notifying Parties: Buyer or Seller Notice of Physical Settlement Notice of Publicly Available Information Applicable	
4. Credit Events:		
Credit Events:	Repudiation/Moratorium Obligation Acceleration Multiple Holder Obligation Not Applicable Failure To Pay Restructuring	
Grace Period Extension:	Applicable	
Payment Requirement:	USD 1,000,000 or its equivalent in relevant Obligation Currency as of the occurrence of the relevant Failure to Pay	
Default Requirement:	USD 10,000,000 or its equivalent in relevant Obligation Currency as of the occurrence of the relevant Credit Event	
Obligations:	*Obligation Category:* Bond	*Obligation Characteristics:* Not Subordinated Not Domestic Currency Not Domestic Issuance Not Domestic Law
Excluded Obligations:	None	
5. Settlement Terms:		
Settlement Method:	Physical Settlement	
Physical Settlement Period:	The longest number of Business Days for settlement in accordance with then current market practice of such Deliverable Obligation as determined by the Calculation Agent after consultation with the parties.	
Deliverable Obligations:	Exclude Accrued Interest	
Deliverable Obligations:	*Deliverable Obligation Category:* Bond	*Deliverable Obligation Characteristics:* Not Subordinated Specified Currencies: Standard Specified Currencies Not Domestic Issuance Not Domestic Law Transferable Not Contingent Not Bearer
Excluded Deliverable Obligations:	None	
Escrow:	Applicable	
6. Other Terms:		
Documentation:	Provided by Seller	
Governing Law:	As per Master Agreement or, if none, English law	
Definitions:	The definitions and provisions in the 2003 ISDA Credit Derivatives Definitions as supplemented by the May 2003 Supplement to the Definitions, as published by the International Swaps and Derivatives Association, Inc. ("ISDA"), (the "Definitions") apply to the Transaction. In the event of any inconsistency between the terms of the Definitions and this term sheet, this term sheet will govern. For the avoidance of doubt, where any term or condition is not set out in this term sheet, the fallback or term or condition set out in the Definitions shall apply.	

APPENDIX II: Default Probabilities Calculated For The Term 03.10.2005 – 05.12.2005

Probabilities Calculated For Recovery Rate of 25%

DATE	P0	P1	P2	P3	P4	S0	S1	S2	S3	S4
03.10.2005	0,0026	0,0581	0,0594	0,0602	0,0588	0,99741	0,93945	0,88366	0,83050	0,78169
04.10.2005	0,0050	0,0563	0,0588	0,0587	0,0593	0,99496	0,93897	0,88378	0,83190	0,78257
05.10.2005	0,0058	0,0559	0,0585	0,0592	0,0585	0,99418	0,93864	0,88376	0,83146	0,78283
06.10.2005	0,0086	0,0561	0,0590	0,0584	0,0604	0,99136	0,93577	0,88060	0,82915	0,77906
07.10.2005	0,0048	0,0566	0,0588	0,0601	0,0594	0,99521	0,93889	0,88368	0,83061	0,78123
10.10.2005	0,0048	0,0566	0,0588	0,0603	0,0592	0,99521	0,93889	0,88368	0,83042	0,78123
11.10.2005	0,0080	0,0564	0,0593	0,0588	0,0605	0,99200	0,93606	0,88053	0,82875	0,77862
12.10.2005	0,0074	0,0577	0,0598	0,0612	0,0606	0,99264	0,93536	0,87942	0,82559	0,77557
13.10.2005	0,0081	0,0577	0,0604	0,0622	0,0598	0,99187	0,93463	0,87816	0,82353	0,77429
14.10.2005	0,0089	0,0580	0,0605	0,0623	0,0605	0,99111	0,93360	0,87711	0,82246	0,77270
17.10.2005	0,0063	0,0596	0,0598	0,0623	0,0610	0,99367	0,93449	0,87862	0,82390	0,77361
18.10.2005	0,0061	0,0592	0,0595	0,0625	0,0603	0,99393	0,93514	0,87953	0,82453	0,77481
19.10.2005	0,0071	0,0591	0,0593	0,0622	0,0604	0,99290	0,93427	0,87887	0,82420	0,77443
20.10.2005	0,0062	0,0588	0,0589	0,0629	0,0590	0,99380	0,93532	0,88021	0,82481	0,77612
21.10.2005	0,0065	0,0587	0,0585	0,0612	0,0594	0,99354	0,93527	0,88053	0,82662	0,77749
24.10.2005	0,0056	0,0592	0,0592	0,0620	0,0603	0,99444	0,93560	0,88023	0,82569	0,77589
25.10.2005	0,0052	0,0602	0,0615	0,0617	0,0618	0,99483	0,93493	0,87739	0,82326	0,77238
26.10.2005	0,0034	0,0606	0,0621	0,0636	0,0613	0,99664	0,93620	0,87802	0,82217	0,77176
27.10.2005	0,0065	0,0603	0,0617	0,0633	0,0605	0,99355	0,93361	0,87598	0,82049	0,77081
28.10.2005	0,0040	0,0608	0,0621	0,0627	0,0617	0,99599	0,93540	0,87730	0,82229	0,77156
31.10.2005	0,0036	0,0605	0,0612	0,0628	0,0617	0,99638	0,93610	0,87879	0,82363	0,77282
01.11.2005	0,0039	0,0608	0,0615	0,0623	0,0623	0,99612	0,93556	0,87802	0,82336	0,77203
02.11.2005	0,0032	0,0611	0,0618	0,0628	0,0629	0,99677	0,93586	0,87802	0,82290	0,77112
03.11.2005	0,0045	0,0611	0,0631	0,0629	0,0630	0,99548	0,93462	0,87560	0,82057	0,76890
04.11.2005	0,0049	0,0612	0,0634	0,0632	0,0632	0,99509	0,93415	0,87495	0,81965	0,76789
07.11.2005	0,0044	0,0611	0,0630	0,0629	0,0626	0,99561	0,93482	0,87594	0,82084	0,76943
08.11.2005	0,0041	0,0605	0,0622	0,0620	0,0617	0,99586	0,93557	0,87741	0,82299	0,77218
09.11.2005	0,0048	0,0615	0,0635	0,0633	0,0625	0,99522	0,93405	0,87470	0,81931	0,76811
10.11.2005	0,0043	0,0605	0,0621	0,0616	0,0628	0,99574	0,93547	0,87734	0,82332	0,77160
14.11.2005	0,0045	0,0606	0,0628	0,0632	0,0629	0,99548	0,93512	0,87639	0,82100	0,76939
15.11.2005	0,0032	0,0603	0,0623	0,0623	0,0626	0,99677	0,93663	0,87829	0,82358	0,77204
16.11.2005	0,0032	0,0595	0,0613	0,0610	0,0615	0,99677	0,93746	0,87995	0,82624	0,77544
17.11.2005	0,0035	0,0588	0,0609	0,0607	0,0611	0,99651	0,93788	0,88072	0,82722	0,77671
18.11.2005	0,0035	0,0590	0,0613	0,0611	0,0615	0,99651	0,93767	0,88020	0,82642	0,77558
21.11.2005	0,0030	0,0588	0,0609	0,0605	0,0611	0,99703	0,93835	0,88117	0,82784	0,77726
22.11.2005	0,0030	0,0580	0,0603	0,0599	0,0607	0,99702	0,93918	0,88259	0,82973	0,77940
23.11.2005	0,0027	0,0585	0,0599	0,0605	0,0608	0,99728	0,93891	0,88269	0,82927	0,77888
28.11.2005	0,0026	0,0582	0,0587	0,0594	0,0604	0,99741	0,93935	0,88420	0,83167	0,78142
29.11.2005	0,0030	0,0591	0,0596	0,0605	0,0613	0,99703	0,93808	0,88217	0,82884	0,77801
30.11.2005	0,0032	0,0593	0,0595	0,0608	0,0617	0,99677	0,93764	0,88183	0,82821	0,77709
01.12.2005	0,0022	0,0596	0,0602	0,0610	0,0621	0,99780	0,93830	0,88182	0,82799	0,77660
05.12.2005	0,0022	0,0600	0,0607	0,0619	0,0629	0,99780	0,93789	0,88091	0,82636	0,77435

DATE	D0	D1	D2	D3	D4	H0	H1	H2	H3	H4
03.10.2005	0,00259	0,06055	0,11634	0,16950	0,21831	0,0026	0,0580	0,0558	0,0532	0,0488
04.10.2005	0,00504	0,06103	0,11622	0,16810	0,21743	0,00504	0,0560	0,0552	0,0519	0,0493
05.10.2005	0,00582	0,06136	0,11624	0,16854	0,21717	0,00582	0,0555	0,0549	0,0523	0,0486
06.10.2005	0,00864	0,06423	0,11940	0,17085	0,22094	0,00864	0,0556	0,0552	0,0514	0,0501
07.10.2005	0,00479	0,06111	0,11632	0,16939	0,21877	0,00479	0,0563	0,0552	0,0531	0,0494
10.10.2005	0,00479	0,06111	0,11632	0,16958	0,21877	0,00479	0,0563	0,0552	0,0533	0,0492
11.10.2005	0,00800	0,06394	0,11947	0,17125	0,22138	0,00800	0,0559	0,0555	0,0518	0,0501
12.10.2005	0,00736	0,06464	0,12058	0,17441	0,22443	0,00736	0,0573	0,0559	0,0538	0,0500
13.10.2005	0,00813	0,06537	0,12184	0,17647	0,22571	0,00813	0,0572	0,0565	0,0546	0,0492
14.10.2005	0,00889	0,06640	0,12289	0,17754	0,22730	0,00889	0,0575	0,0565	0,0547	0,0498
17.10.2005	0,00633	0,06551	0,12138	0,17610	0,22639	0,00633	0,0592	0,0559	0,0547	0,0503
18.10.2005	0,00607	0,06486	0,12047	0,17547	0,22519	0,00607	0,0588	0,0556	0,0550	0,0497
19.10.2005	0,00710	0,06573	0,12113	0,17580	0,22557	0,00710	0,0586	0,0554	0,0547	0,0498
20.10.2005	0,00620	0,06468	0,11979	0,17519	0,22388	0,00620	0,0585	0,0551	0,0554	0,0487
21.10.2005	0,00646	0,06473	0,11947	0,17338	0,22251	0,00646	0,0583	0,0547	0,0539	0,0491
24.10.2005	0,00556	0,06440	0,11977	0,17431	0,22411	0,00556	0,0588	0,0554	0,0545	0,0498
25.10.2005	0,00517	0,06507	0,12261	0,17674	0,22762	0,00517	0,0599	0,0575	0,0541	0,0509
26.10.2005	0,00336	0,06380	0,12198	0,17783	0,22824	0,00336	0,0604	0,0582	0,0558	0,0504
27.10.2005	0,00645	0,06639	0,12402	0,17951	0,22919	0,00645	0,0599	0,0576	0,0555	0,0497
28.10.2005	0,00401	0,06460	0,12270	0,17771	0,22844	0,00401	0,0606	0,0581	0,0550	0,0507
31.10.2005	0,00362	0,06390	0,12121	0,17637	0,22718	0,00362	0,0603	0,0573	0,0552	0,0508
01.11.2005	0,00388	0,06444	0,12198	0,17664	0,22797	0,00388	0,0606	0,0575	0,0547	0,0513
02.11.2005	0,00323	0,06414	0,12198	0,17710	0,22888	0,00323	0,0609	0,0578	0,0551	0,0518
03.11.2005	0,00452	0,06538	0,12440	0,17943	0,23110	0,00452	0,0609	0,0590	0,0550	0,0517
04.11.2005	0,00491	0,06585	0,12505	0,18035	0,23211	0,00491	0,0609	0,0592	0,0553	0,0518
07.11.2005	0,00439	0,06518	0,12406	0,17916	0,23057	0,00439	0,0608	0,0589	0,0551	0,0514
08.11.2005	0,00414	0,06443	0,12259	0,17701	0,22782	0,00414	0,0603	0,0582	0,0544	0,0508
09.11.2005	0,00478	0,06595	0,12530	0,18069	0,23189	0,00478	0,0612	0,0593	0,0554	0,0512
10.11.2005	0,00426	0,06453	0,12266	0,17668	0,22840	0,00426	0,0603	0,0581	0,0540	0,0517
14.11.2005	0,00452	0,06488	0,12361	0,17900	0,23061	0,00452	0,0604	0,0587	0,0554	0,0516
15.11.2005	0,00323	0,06337	0,12171	0,17642	0,22796	0,00323	0,0601	0,0583	0,0547	0,0515
16.11.2005	0,00323	0,06254	0,12005	0,17376	0,22456	0,00323	0,0593	0,0575	0,0537	0,0508
17.11.2005	0,00349	0,06212	0,11928	0,17278	0,22329	0,00349	0,0586	0,0572	0,0535	0,0505
18.11.2005	0,00349	0,06233	0,11980	0,17358	0,22442	0,00349	0,0588	0,0575	0,0538	0,0508
21.11.2005	0,00297	0,06165	0,11883	0,17216	0,22274	0,00297	0,0587	0,0572	0,0533	0,0506
22.11.2005	0,00298	0,06082	0,11741	0,17027	0,22060	0,00298	0,0578	0,0566	0,0529	0,0503
23.11.2005	0,00272	0,06109	0,11731	0,17073	0,22112	0,00272	0,0584	0,0562	0,0534	0,0504
28.11.2005	0,00259	0,06065	0,11580	0,16833	0,21858	0,00259	0,0581	0,0551	0,0525	0,0502
29.11.2005	0,00297	0,06192	0,11783	0,17116	0,22199	0,00297	0,0589	0,0559	0,0533	0,0508
30.11.2005	0,00323	0,06236	0,11817	0,17179	0,22291	0,00323	0,0591	0,0558	0,0536	0,0511
01.12.2005	0,00220	0,06170	0,11818	0,17201	0,22340	0,00220	0,0595	0,0565	0,0538	0,0514
05.12.2005	0,00220	0,06211	0,11909	0,17364	0,22565	0,00220	0,0599	0,0570	0,0546	0,0520

Probabilities Calculated For Recovery Rate of 50%

TARİH	P0	P1	P2	P3	P4	S0	S1	S2	S3	S4
03.10.2005	0,0038	0,0853	0,0871	0,0882	0,0862	0,99617	0,91124	0,83186	0,75848	0,69307
04.10.2005	0,0075	0,0826	0,0862	0,0861	0,0870	0,99255	0,91055	0,83202	0,76037	0,69423
05.10.2005	0,0086	0,0820	0,0858	0,0868	0,0858	0,99141	0,91008	0,83199	0,75977	0,69456
06.10.2005	0,0128	0,0823	0,0865	0,0857	0,0886	0,98724	0,90598	0,82761	0,75666	0,68963
07.10.2005	0,0071	0,0831	0,0863	0,0881	0,0872	0,99293	0,91044	0,83190	0,75863	0,69248
10.10.2005	0,0071	0,0831	0,0863	0,0884	0,0869	0,99293	0,91044	0,83190	0,75837	0,69248
11.10.2005	0,0118	0,0828	0,0870	0,0863	0,0887	0,98819	0,90639	0,82751	0,75612	0,68907
12.10.2005	0,0109	0,0847	0,0877	0,0897	0,0888	0,98914	0,90539	0,82597	0,75187	0,68508
13.10.2005	0,0120	0,0847	0,0886	0,0911	0,0877	0,98801	0,90434	0,82422	0,74911	0,68341
14.10.2005	0,0131	0,0851	0,0887	0,0913	0,0887	0,98688	0,90286	0,82278	0,74766	0,68134
17.10.2005	0,0093	0,0873	0,0877	0,0912	0,0895	0,99065	0,90415	0,82487	0,74961	0,68253
18.10.2005	0,0090	0,0867	0,0872	0,0916	0,0884	0,99103	0,90506	0,82612	0,75045	0,68409
19.10.2005	0,0105	0,0866	0,0870	0,0911	0,0886	0,98952	0,90383	0,82522	0,75000	0,68359
20.10.2005	0,0092	0,0863	0,0864	0,0922	0,0866	0,99084	0,90532	0,82707	0,75082	0,68579
21.10.2005	0,0095	0,0860	0,0859	0,0897	0,0872	0,99046	0,90525	0,82751	0,75325	0,68758
24.10.2005	0,0082	0,0868	0,0868	0,0908	0,0884	0,99179	0,90574	0,82710	0,75200	0,68549
25.10.2005	0,0076	0,0883	0,0902	0,0904	0,0906	0,99237	0,90477	0,82317	0,74874	0,68093
26.10.2005	0,0050	0,0889	0,0910	0,0931	0,0899	0,99503	0,90658	0,82404	0,74729	0,68012
27.10.2005	0,0095	0,0884	0,0905	0,0928	0,0888	0,99048	0,90288	0,82121	0,74502	0,67888
28.10.2005	0,0059	0,0892	0,0910	0,0919	0,0904	0,99408	0,90544	0,82304	0,74744	0,67985
31.10.2005	0,0053	0,0887	0,0897	0,0919	0,0904	0,99465	0,90644	0,82510	0,74924	0,68149
01.11.2005	0,0057	0,0891	0,0901	0,0912	0,0914	0,99427	0,90567	0,82403	0,74887	0,68045
02.11.2005	0,0048	0,0896	0,0906	0,0920	0,0922	0,99522	0,90610	0,82403	0,74825	0,67928
03.11.2005	0,0067	0,0896	0,0925	0,0921	0,0923	0,99333	0,90432	0,82069	0,74513	0,67639
04.11.2005	0,0072	0,0898	0,0928	0,0926	0,0925	0,99276	0,90365	0,81979	0,74390	0,67508
07.11.2005	0,0065	0,0895	0,0923	0,0922	0,0917	0,99352	0,90462	0,82116	0,74548	0,67708
08.11.2005	0,0061	0,0887	0,0911	0,0909	0,0905	0,99389	0,90568	0,82319	0,74837	0,68065
09.11.2005	0,0071	0,0901	0,0931	0,0927	0,0916	0,99295	0,90352	0,81944	0,74345	0,67536
10.11.2005	0,0063	0,0887	0,0911	0,0903	0,0920	0,99370	0,90555	0,82309	0,74880	0,67990
14.11.2005	0,0067	0,0889	0,0920	0,0926	0,0921	0,99333	0,90505	0,82177	0,74570	0,67703
15.11.2005	0,0048	0,0884	0,0913	0,0913	0,0917	0,99523	0,90720	0,82440	0,74916	0,68047
16.11.2005	0,0048	0,0873	0,0899	0,0895	0,0901	0,99522	0,90838	0,82670	0,75273	0,68490
17.11.2005	0,0052	0,0863	0,0893	0,0891	0,0895	0,99484	0,90899	0,82777	0,75405	0,68654
18.11.2005	0,0052	0,0866	0,0899	0,0896	0,0902	0,99484	0,90869	0,82704	0,75297	0,68508
21.11.2005	0,0044	0,0863	0,0893	0,0888	0,0896	0,99560	0,90966	0,82840	0,75488	0,68727
22.11.2005	0,0044	0,0851	0,0884	0,0878	0,0889	0,99560	0,91084	0,83036	0,75743	0,69006
23.11.2005	0,0040	0,0859	0,0878	0,0887	0,0891	0,99598	0,91046	0,83051	0,75681	0,68939
28.11.2005	0,0038	0,0854	0,0861	0,0872	0,0886	0,99617	0,91109	0,83261	0,76004	0,69271
29.11.2005	0,0044	0,0867	0,0874	0,0887	0,0899	0,99560	0,90928	0,82978	0,75622	0,68825
30.11.2005	0,0048	0,0870	0,0873	0,0892	0,0904	0,99522	0,90864	0,82931	0,75537	0,68705
01.12.2005	0,0033	0,0874	0,0883	0,0895	0,0910	0,99675	0,90959	0,82931	0,75509	0,68641
05.12.2005	0,0032	0,0880	0,0891	0,0908	0,0922	0,99675	0,90900	0,82804	0,75289	0,68348

TARİH	D0	D1	D2	D3	D4	H0	H1	H2	H3	H4
03.10.2005	0,00383	0,08876	0,16814	0,24152	0,30693	0,00383	0,08492	0,07938	0,07338	0,06541
04.10.2005	0,00745	0,08945	0,16798	0,23963	0,30577	0,00745	0,08200	0,07853	0,07165	0,06614
05.10.2005	0,00859	0,08992	0,16801	0,24023	0,30544	0,00859	0,08133	0,07808	0,07223	0,06521
06.10.2005	0,01276	0,09402	0,17239	0,24334	0,31037	0,01276	0,08127	0,07837	0,07095	0,06703
07.10.2005	0,00707	0,08956	0,16810	0,24137	0,30752	0,00707	0,08248	0,07855	0,07326	0,06616
10.10.2005	0,00707	0,08956	0,16810	0,24163	0,30752	0,00707	0,08248	0,07855	0,07353	0,06589
11.10.2005	0,01181	0,09361	0,17249	0,24388	0,31093	0,01181	0,08180	0,07888	0,07140	0,06705
12.10.2005	0,01086	0,09461	0,17403	0,24813	0,31492	0,01086	0,08375	0,07942	0,07411	0,06678
13.10.2005	0,01199	0,09566	0,17578	0,25089	0,31659	0,01199	0,08366	0,08012	0,07511	0,06570
14.10.2005	0,01312	0,09714	0,17722	0,25234	0,31866	0,01312	0,08401	0,08008	0,07512	0,06632
17.10.2005	0,00935	0,09585	0,17513	0,25039	0,31747	0,00935	0,08650	0,07929	0,07526	0,06708
18.10.2005	0,00897	0,09494	0,17388	0,24955	0,31591	0,00897	0,08597	0,07894	0,07568	0,06636
19.10.2005	0,01048	0,09617	0,17478	0,25000	0,31641	0,01048	0,08569	0,07861	0,07521	0,06642
20.10.2005	0,00916	0,09468	0,17293	0,24918	0,31421	0,00916	0,08552	0,07825	0,07625	0,06503
21.10.2005	0,00954	0,09475	0,17249	0,24675	0,31242	0,00954	0,08521	0,07774	0,07426	0,06567
24.10.2005	0,00821	0,09426	0,17290	0,24800	0,31451	0,00821	0,08605	0,07864	0,07509	0,06651
25.10.2005	0,00763	0,09523	0,17683	0,25126	0,31907	0,00763	0,08759	0,08160	0,07444	0,06781
26.10.2005	0,00497	0,09342	0,17596	0,25271	0,31988	0,00497	0,08845	0,08254	0,07675	0,06717
27.10.2005	0,00952	0,09712	0,17879	0,25498	0,32112	0,00952	0,08759	0,08167	0,07618	0,06615
28.10.2005	0,00592	0,09456	0,17696	0,25256	0,32015	0,00592	0,08864	0,08241	0,07560	0,06759
31.10.2005	0,00535	0,09356	0,17490	0,25076	0,31851	0,00535	0,08821	0,08134	0,07586	0,06775
01.11.2005	0,00573	0,09433	0,17597	0,25113	0,31955	0,00573	0,08860	0,08163	0,07517	0,06841
02.11.2005	0,00478	0,09390	0,17597	0,25175	0,32072	0,00478	0,08913	0,08207	0,07578	0,06897
03.11.2005	0,00667	0,09568	0,17931	0,25487	0,32361	0,00667	0,08900	0,08363	0,07556	0,06874
04.11.2005	0,00724	0,09635	0,18021	0,25610	0,32492	0,00724	0,08910	0,08387	0,07589	0,06882
07.11.2005	0,00648	0,09538	0,17884	0,25452	0,32292	0,00648	0,08890	0,08346	0,07568	0,06840
08.11.2005	0,00611	0,09432	0,17681	0,25163	0,31935	0,00611	0,08821	0,08249	0,07482	0,06772
09.11.2005	0,00705	0,09648	0,18056	0,25655	0,32464	0,00705	0,08943	0,08407	0,07600	0,06808
10.11.2005	0,00630	0,09445	0,17691	0,25120	0,32010	0,00630	0,08816	0,08245	0,07429	0,06890
14.11.2005	0,00667	0,09495	0,17823	0,25430	0,32297	0,00667	0,08828	0,08327	0,07607	0,06867
15.11.2005	0,00477	0,09280	0,17560	0,25084	0,31953	0,00477	0,08802	0,08280	0,07524	0,06869
16.11.2005	0,00478	0,09162	0,17330	0,24727	0,31510	0,00478	0,08684	0,08168	0,07397	0,06783
17.11.2005	0,00516	0,09101	0,17223	0,24595	0,31346	0,00516	0,08586	0,08122	0,07372	0,06750
18.11.2005	0,00516	0,09131	0,17296	0,24703	0,31492	0,00516	0,08615	0,08165	0,07408	0,06789
21.11.2005	0,00440	0,09034	0,17160	0,24512	0,31273	0,00440	0,08594	0,08126	0,07352	0,06761
22.11.2005	0,00440	0,08916	0,16964	0,24257	0,30994	0,00440	0,08476	0,08048	0,07293	0,06737
23.11.2005	0,00402	0,08954	0,16949	0,24319	0,31061	0,00402	0,08552	0,07995	0,07370	0,06743
28.11.2005	0,00383	0,08891	0,16739	0,23996	0,30729	0,00383	0,08509	0,07848	0,07257	0,06733
29.11.2005	0,00440	0,09072	0,17022	0,24378	0,31175	0,00440	0,08632	0,07950	0,07356	0,06797
30.11.2005	0,00478	0,09136	0,17069	0,24463	0,31295	0,00478	0,08658	0,07933	0,07394	0,06832
01.12.2005	0,00325	0,09041	0,17069	0,24491	0,31359	0,00325	0,08716	0,08029	0,07422	0,06868
05.12.2005	0,00325	0,09100	0,17196	0,24711	0,31652	0,00325	0,08775	0,08096	0,07515	0,06941