HANDBOOK
ON CASH FLOW MARGINING MODEL TO BE APPLICABLE TO THE DEBT SECURITIES MARKET AFTER BISTECH® TRANSITION AND CCP SERVICE

Central Counterparty Department

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1. OVERVIEW

BISTECH Technological Transformation Program initiated on January 2014 in accordance with the strategic partnership agreement signed between Borsa Istanbul and NASDAQ aims the revision and re-development of the Genium INET software being used by the leading exchanges worldwide and of other related technological components in a compatible manner with the Turkish capital markets legislation.

BISTECH consisting of numerous large-scale projects under a main program, is an extensive program covering technological, organizational and operational developments, spreading over the years. The first tangible outcome of this program has been the successful introduction of the new technology in Borsa Istanbul Equity Market on November 30, 2015. Under the second phase of the program, the Futures and Options Market has made a successful transmission at the same level on March 6, 2017 and begun to run on the BISTECH system. Having arrived at the last phase of the program, the studies for transmission of the Debt Securities Market and the Precious Metals and Stones Market to the BISTECH system continue.

As part of the BISTECH project being introduced, Takasbank provides CCP service in the Equity Market and the Futures and Options Market. The Delta Hedge Margin Model used in the risk management while providing this service is assimilated to the SPAN method which has been used prior to BISTECH.

In the upcoming period, upon BISTECH transition in the Debt Securities Market, Takasbank shall start to provide CCP service in that market. The risk and collateral management currently carried out by Borsa Istanbul shall be started to be made by Takasbank CCP Department. In this context, the Cash Flow Margining – CFM – method in the BISTECH infrastructure shall be used in the risk management system.

In this paper, the methodology in the Cash Flow Margining method to be used in the Debt Securities Market shall be explained and security-based calculation examples shall be provided.

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ABBREVIATIONS

DSM	Debt Securities Market
BRSA	Banking Regulation and Supervision Agency
BIST30	Borsa Istanbul 30 Index
CFM	Cash Flow Margining
GDDS	Government Domestic Debt Securities
ENDP	Eurobond Negotiated Deals Platform
MBS	Mortgage-Backed Securities
MFI	Mortgage Finance Institutions
MCS	Mortgage-Covered Securities
HFF	Housing Finance Fund
HFI	Housing Finance Institutions
CCP	Central Counterparty
MKTRP	Repo Market for Specified Securities
NPV	Net Present Value
PSDI	Private Sector Debt Instruments
PC	Principal Components
SPAN	Standardized Portfolio Analysis of Risk
CPI	Consumer Price Index
TÜİK	Turkish Statistical Institute
IBM	International Bond Market
ABS	Asset-Backed Securities
AFF	Asset Finance Fund
FOM	Futures and Options Market
VKŞ	Asset Leasing Company
ACS	Asset-Covered Securities
XTK	Takasbank member defined in BISTECH system

2. INTRODUCTION

After the transition to BISTECH infrastructure in Borsa Istanbul Debt Securities Market (DSM), the risk and collateral services to be performed for such market shall be transferred to the body of Takasbank. The risk and collateral calculation methodology intended to be used in the Debt Securities Market is the Cash Flow Margining ("CFM") model designed for the fixed income financial products. CFM is based on a risk calculation over the stress scenarios to be applied to the yield curves of fixed income securities being created by various techniques. In addition, CFM also allows for identification of correlation among the stress scenarios to be applied to different yield curves.

As in all other risk models, the purpose of CFM is also to calculate the margin requirement of the positions generated by the fixed income securities. CFM method is considered to be a comprehensive margining method which takes into account the relationship of trade, position and portfolio values with the risk level.

Total margin requirement generated by the CFM is basically comprised of the initial margin and variation margin. The difference between the stressed and unstressed net present values makes up the initial margin. On the other hand, the difference between the trade price and the last price forms the variation margin. The deposited collateral against the generated margin obligations are valued in the BISTECH system in the manner currently processed in the Futures and Options Market and the Equity Market. The intraday and end-of-day margin calls are determined after comparing the risk calculated by the CFM method with the margin amounts valued in the BICTECH system.

3. CASH FLOWS

As is implied by its name, at the heart of the CFM method lays the future cash flows of the asset subject to the assessment. When the margin requirement is calculated, all fixed income securities are represented as a collection of their own cash flows. To that end, each instrument's net present value (NPV) in a given scenario is defined as the sum of the net present values of all cash flows of that instrument. The cash flows with which CFM deals are divided into two groups.

3.1. Fixed Cash Flows

The cash flow which are constant and known before hand is named as a fixed cash flow. They can be any of the following;

- Bond/Bill notional amount paid on maturity.
- Bond or swap coupons.
- Bilateral payments subject to repo transactions.
- Floating cash flows whose payment have been made fixed

The fixed cash flows expected to occur in the future are discounted down to today and their NPVs are calculated.

3.2. Floating Cash Flows

The cash flows whose size is currently unknown can be considered as floating cash flows. The size of the cash flow can be determined at some pre-defined point in time in the future. The NPVs of the floating cash flows are calculated by way of first forecasting such flows and then discounting these value down to today. One thing worth noting about the CFM is that the cash flows are generated from the data of the relevant asset and by making them subject to valuation in various market scenarios. To calculate an asset's market value in the most accurate manner, the yield curves which act as price bearers are of great importance for forecasting and discounting the floating cash flows.

4. YIELD CURVES

The yield curve, which is also referred to as return curve, is a graphical illustration of the relationship between the interest rates and the maturities. The shape of yield curve is an important indicator which enables the economists, investors and the decision makers such the central banks etc. to make forecasts about the future condition of the market and the economy and take decisions for the future accordingly. In another saying, the yield curve is a graphical representation of the relationship, at any point in time, between the different maturities of an investment instrument and their yields on these maturities.

The vertical axis displays the yield and the horizontal axis displays the maturities. The yield curves are classified as positive (normal) yield curve, negative (inverted) yield curve, flat yield curve and bell-shaped yield curve indicating higher return in the medium terms.

The moves of the curve overtime are called;

- "Steeping" (in case of a positive slope curve, upward move in the curve's panel away from the origin, downward move in its panel close to the origin, increase in slope).
- "Flattening" (in case of a positive slope yield curve, downward move in the curve's panel away from the origin, upward move in its panel close to the origin, decrease in slope).
- An upward shape-preserving slope of the curve is called as "parallel shift".

Increase in the curve's slope reflects the anticipation that interest rates (inflation) will rise in the long term. On the other hand, decrease in the slope, in other words, flattening of a positive yield curve (where the panel close to the origin moves up and the panel away from the origin moves down) means that the investors would head towards the long term to benefit longer from the prevailing interest rates based on the anticipation that the interest rates will fall in the future, and thus, the yield on such maturity would decrease due to increasing demand, where the fund demanders would prefer short term by expecting that an opportunity to borrow with lower interest would arise and, hence, the return would increase as a result of excess supply.

One of the most important functions of the Cash Flow Margining model is that it can calculate the present values of the future cash flows. To make such calculation, the system requires yield curves through which we can discount down the cash flows to today.

Different yield curves can be generated depending on the type of instrument to be collateralized, and the generated yield curves can also be used for different risk calculations depending again on the instrument type.

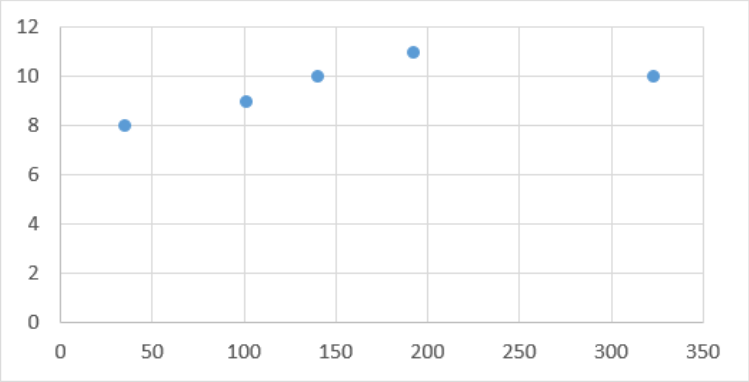
The yield curve, which can be defined as a graphical illustration of the relationship at a specific point in time between the various maturities of an investment instrument and its yields at such maturities, is a curve demonstrating the rates of return differing across maturities of the financial instruments having same credit risk, liquidity and tax characteristics but different

maturity dates. Turkish Lira and foreign currency yield curves to be pictured in the system shall use the simple interest rates of the discounted and fixed coupon rate debt instruments issued by the Republic of Turkey Undersecretariat of Treasury and traded on the relevant day. Besides that, different types of yield curves are also pictured by using the private sector bonds. Accordingly, the theoretical prices of GDDSs, PSDSs and of Eurobonds issued by the Republic of Turkey Undersecretariat of Treasury are set by using the risk-free interest rates.

The first step in building a Turkish Lira yield curve is to place the observed interest rates of the discounted Government Domestic Debt Securities on the maturity/yield (interest rate) coordinate axis.

Table 1 - Creating the points of yield curve

ISIN	Vadeye Kalan Süre (Gün)	Faiz Oranı (%)
TRTAAA	35	8
TRTBBB	101	9
TRTCCC	140	10
TRTDDD	192	11
TRTEEE	323	10



The next step in building a yield curve is to combine the observed interest rates and transform them in the maturity-yield space from discrete pattern to continuous form. The system can combine the observed interest rate points by the linear and cubic spline methods. The explanations about the said methods are given below.

4.1. Linear Spline Method

If the linear spline method is used in the process of transforming the interest rates from discrete pattern to continuous pattern to build a yield curve, the observed interest rate points are combined with a first degree function. The mathematical function that must be used for the generated linear interest interpolation is given below.

$$f(r_x) = r_i + m_{i,i+1} * (\frac{T_x - T_i}{365})$$

r_x= Interest rate to be calculated for point x.

r_i=i Interest rate known for point i.

$m_{i,i+1}$=Slope between the interest rate known for point i and the interest rate known for point (i+1).

T_x= Number of days remaining to maturity at point x ($T_x \epsilon [T_i, T_{i+1}]$)

T_i= Number of days remaining to maturity at point i.

The yield curve is made continuous by creating a new function between every 2 points whose interest rates are known. As the number of observed interest rates used for designing a yield curve increases, it is assumed that the yield curve's ability to explain the maturity-yield preferences also increases.

4.2. Cubic Spline Method

The main purpose of the cubic spline method which generally produces precise results in pricing of the financial instruments with nonlinear nature is to create a yield curve whose 1st derivative and 2nd derivate are flatter. Thus, the resulting inter-point function is 3rd degree.

The function between 2 points can be shown as follows:

$$S_j(t) = a_j + b_j * \frac{(t - t_j)}{365} + c_j * (\frac{t - t_j}{365})^2 + d_j * (\frac{t - t_j}{365})^3$$

$S_j(t)$ = Interest rate to be calculated for point j.

t = Number of days remaining to maturity ($t \epsilon [t_j, t_{j+1}]$)

t_j= Number of days remaining to maturity at time j.

In order for the yield curve to become continuous, a_j, b_j, c_j and d_j values between every 2 points whose interest rates are known must be found. In order for these four unknowns to be found, 4 polynomials whose mathematical result is known are required:

- Since it is the initial interest rate data between 2 points; $S_j(x_j) = y_j$
- Since it is the final interest rate data between 2 points; $S_j(x_{j+1}) = y_{j+1}$
- Since the 1st derivative must be equal to zero; $S_j'(x_j) = 0$
- Since the 2nd derivative must also be equal to zero; $S_j''(x_j) = 0$

a_j , b_j , c_j and d_j haircuts are found for each range as a result of the calculations made by the outcome of these known polynomials and the yield curve is made continuous.

4.3. Bootstrap Method

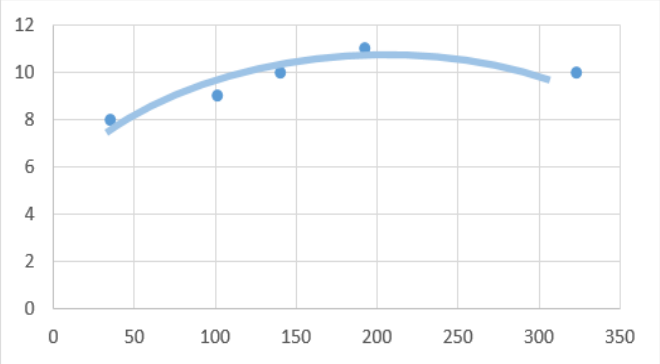
The third step in building a yield curve is to add the fixed coupon rate bonds to the yield curve and extend the maturity period covered by the curve. For that purpose, the cash flows of the fixed coupon rate bonds that have been traded, in other words, have a certain market price and to be used in building the yield curve are firstly stripped starting from the one with the shortest term.

The net present values of the cash flows falling into the maturity period of the current yield curve are calculated by interpolating the interests in the yield curve, and an interest rate iteration is made for the cash flows falling out of the current yield curve's maturity period, whose interest rates are not clear; and the main purpose of such interest iteration is to determine the interest rate that equates the sum of all coupon cash flows with the market price of the bond.

For example; let's assume that the yield curve generated by placing the interest rates of the discounted Government Domestic Debt Securities on the maturity-yield (interest rate) coordinate axis and filling out their lags is as given in the below figure. The maturity period of the yield curve generated through the discounted GDDSs is 323 days.

Table 2 - Combining the points of yield curve

ISIN	Vadeye Kalan Süre (Gün)	Faiz Oranı (%)
TRTAAA	35	8
TRTBBB	101	9
TRTCCC	140	10
TRTDDD	192	11
TRTEEE	323	10



The cash flows of the fixed rate bond whose price is known (99 TL) and to be used for extending the yield curve are given below.

Table 3 - Cash flows of a fixed rate bond

Coupon Rate	Remaining Term to Coupon (Days)	Known Rates of Return	Net Present Value
5	170	10.5	4.767
105 (principal included)	350	X	Y

This process referred to as Bootstrap is repeated for all assets including the longest term bond whose price has been formed in the market.

5. PRINCIPAL COMPONENT ANALYSIS

The present value of the future cash values calculated through the generated yield curve would change depending on any change to be occurred in its shape. The yield curve may be exposed to various shifts, however, the three principal components of the curve are in nature capable of explaining the majority of all changes that may occur based on the results derived from the empirical studies.

In this section, the first 3 principal components are tried to be defined from an economic perspective. Besides that, a general explanation is to be provided about how the CFM employs the stressed scenario-applied yield curves for use in its margin requirement calculations.

The principal components (PCs) can be defined as uncorrelated variances in the yield curves.

5.1. PC 1: Parallel Shift

The first principal component for the yield curves is a parallel shift of the entire curve. This component generally covers approximately 75%-85% of the former fluctuations of the yield curve. In addition, the fact that changing economic factors result in a rise or fall in the interest market as a whole appears as an understandable situation.

5.2. PC 2: Change in Slope

The second principal component is a change in the curve's slope. This component generally explains approximately 10%-10% of the former fluctuations of the curve.

5.3. PC 3: Change in Curvature

The third component is a change in the curve's curvature. This last component generally explains approximately 3%-5% of the former fluctuations of the curve.

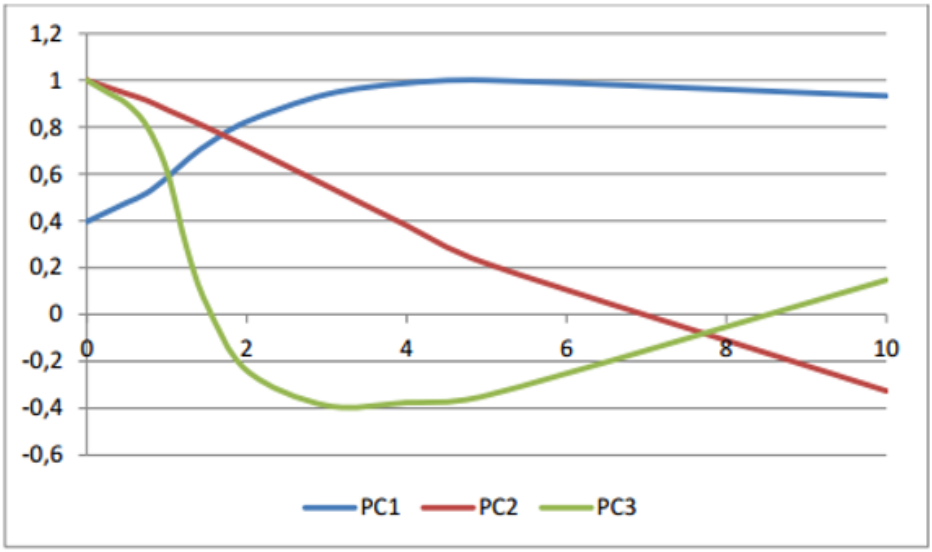


Figure 1 - PC1, PC2 and PC3 illustration of the yield curve

5.4. Shocking the curve by principal components

The first three principal components explain most of the fluctuations that may occur; hence, the linear combinations of the principal components can be used to simulate the changes in the curve with minimum error.

Quarterly assessments shall be performed in the BISTECH system, and the 3 principal components applied to each yield curve shall be updated, when necessary, together with the risk parameters that will designate at which rate the principal components are to be used.

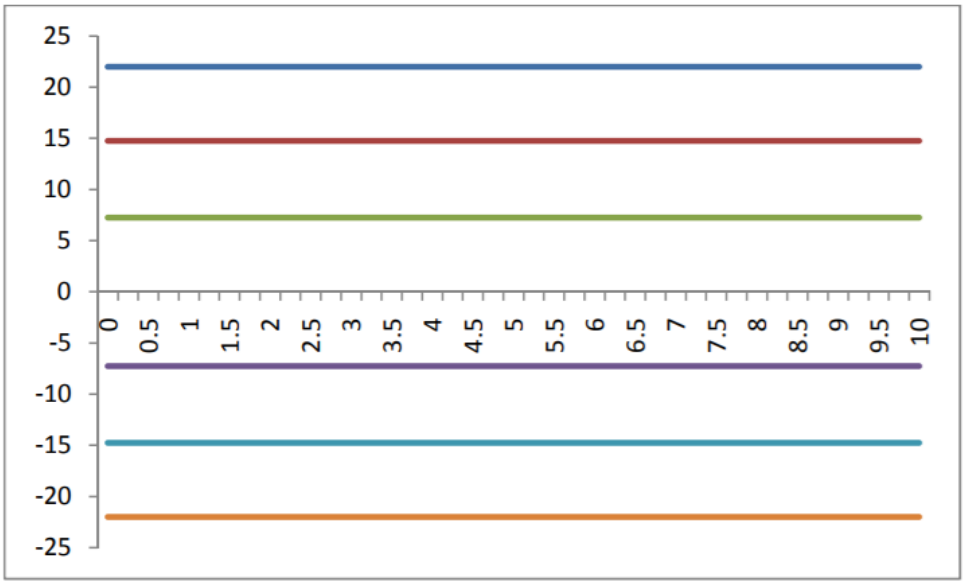


Figure 2 - Shocked yield curve by PC1 (different degrees of parallel shifts)

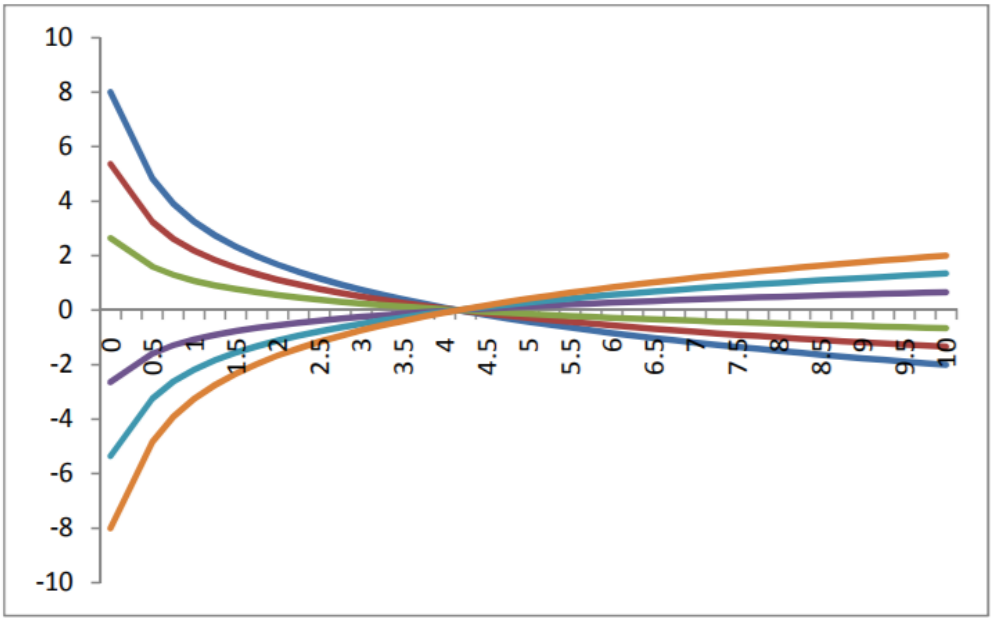


Figure 3 - Shocked yield curve by PC2 (different degrees of curvature)

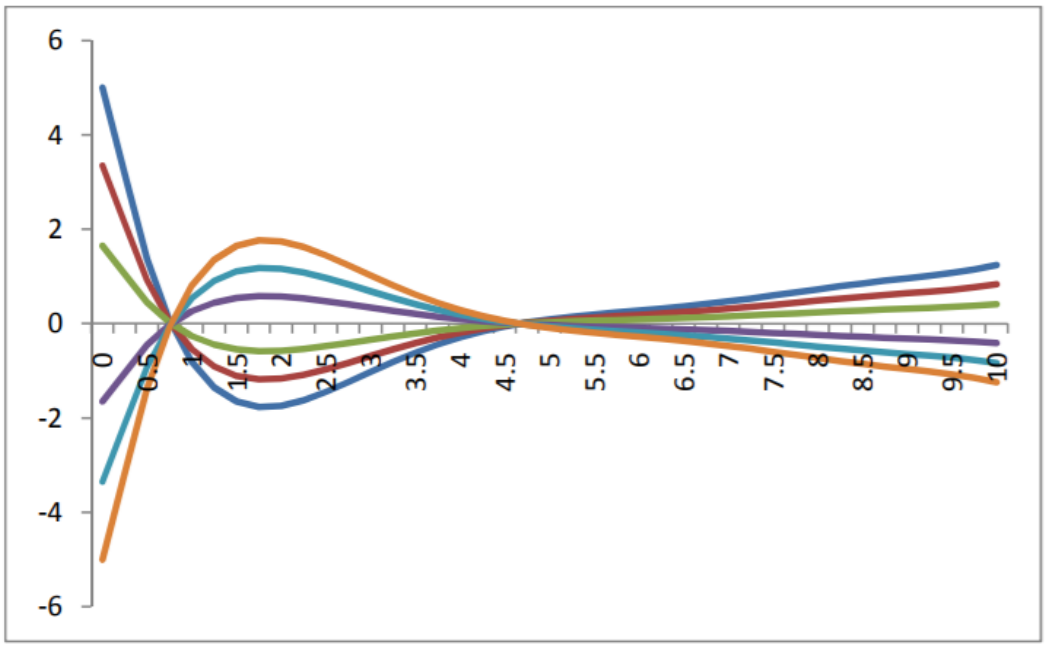


Figure 4 - Shocked yield curve by PC3 (different degrees of change in the slope's angle)

BISTECH system extends the yield curve by applying the "bootstrap" method to the formal spot curve at each trading day. These curves are those that constitute the basis for shaping the shocked curves. The following equation is used in the simulation of the curve generated by shocking the formal curve. The system defines the yield curves and their principal components as vectors.

$$Curve_{Stressed} = Curve_t + a * PC1 + b * PC2 + c * PC3$$

a, b and c might get +/- values between the range of the risk parameters of each principal components.

The margin requirement is calculated over the curve scenario that converges to the worst market conditions assumption.

6. RISK CALCULATION

Lying at the heart of the CFM methodology are the cash flows of the financial assets, the curves acting as price bearers and the principal components of these curves. How these notions are to be used in margin calculations may vary according to the market model.

A common issue for all instruments is that the initial margins of these products are calculated by a single curve, that is, by a "zero-coupon curve". Having a general methodology for the valuation when designing different market scenarios enables the clearing and settlement institution to define a correlation between different curves. The financial instruments differ in themselves depending on how their market values are, hence the variation margin is, calculated.

The Cash Flow Margining Method to be used together with the BISTECH system calculates the initial and variation margins for the members to cover the risks arising from the security positions to which CCP service is provided in the Debt Securities Market. The initial margin is received at the beginning to cover, in case of default of the member, any price change that might occur in the market during the time period elapsed from the moment the default has occurred to its resolution. Variation margin, on the other hand, is required for the difference between the current values of the positions and their market prices.

The initial margin amounts to the difference between the net present values calculated by using the relevant yield curves of the cash flows subject to the transaction and the net present values calculated after the shocks applied to these curves.

Initial Margin =

(Unshocked Net Present Value of Cash Subject to Settlement - Shocked Net Present Value of Cash Subject to Settlement) + (Unshocked Net Present Value of Asset Subject to Settlement - Shocked Net Present Value of Asset Subject to Settlement)

In the Debt Securities Market Cash Flow Margining Method, the variation margin amounts to the sum of the differences between the settlement prices (trade prices) of the assets subject to the transaction and the theoretical price calculated by using the yield curve to which the asset is linked. The variation margin may increase or decrease the total margin requirement.

*Variation Margin = Position Amount * (Theoretical Price – Settlement Price)*

In the variation margin calculations, the current trade prices occurring in the market may also be taken as the base instead of the theoretical price. Takasbank is entitled to determine the

method to be used on the basis of the member and asset type by taking account of the market conditions.

*Variation Margin= Position Amount * (Current Price - Settlement Price)*

Total margin requirement is equal to the sum of the initial margin and the variation margin.

Margin Requirement = Initial Margin + Variation Margin

In addition to the risk calculation we roughly outlined above, the explanations on what type of margin calculation specific to the assets traded in Borsa Istanbul Debt Securities Market is to be made shall be provided together with the examples in this section. The markets in Borsa Istanbul Debt Securities are as follows. Along with the markets given in the figure, another market names as the Committed Transaction Market shall also be traded under the market upon BISTECH transition.

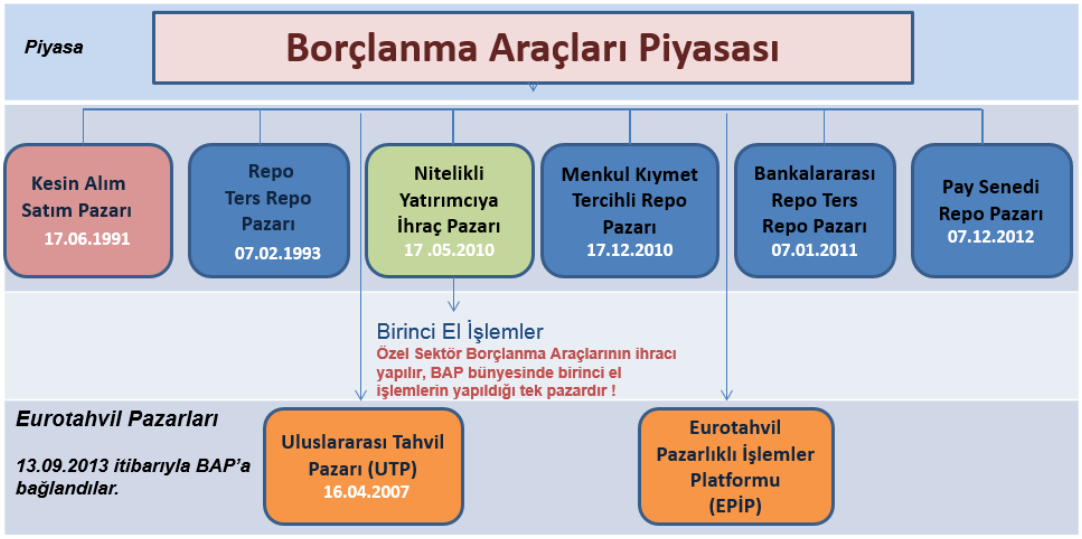


Figure 5 - Markets of Debt Securities Market

6.1. (Outright Purchases and Sales Market) - (Offering Market for Qualified Investors) - (International Bonds Market) - (Eurobond Negotiated Deals Platform) Products

In the Cash Flow Margining Method, the cash flows and the type of asset are important rather than the market in which the assets are traded. For this reason, we will explain the risk

calculation methods according to the asset type. The types of assets traded in the Outright Purchases and Sales Market, Offering Market for Qualified Investors, International Bonds Market and Eurobond Negotiated Deals Platform being the sub-markets of Borsa Istanbul Debt Securities Market are as follows:

- Government Domestic Debt Securities
  - Discounted Government Bonds
  - Fixed Coupon Payment Government Bonds
  - Floating Coupon Payment Government Bonds
  - Inflation-Indexed Coupon Payment Government Bonds
- Government Lease Certificates
  - Fixed Lease Payment Government Lease Certificates
  - Inflation-Indexed Lease Payment Government Lease Certificates
  - Fixed Lease Payment Government Lease Certificates Issued Abroad
- Stripped Forms of Coupon/Lease Payment Government Domestic Debt Securities
  - Stripped Coupons/Leases of Coupon/Lease Payment Government Domestic Debt Securities
  - Stripped Principals of Coupon/Lease Payment Government Domestic Debt Securities
- Government Eurobonds
- Private Sector Debt Instruments
  - Discounted Private Sector Debt Instruments
  - Fixed and Floating Coupon Payment Private Sector Debt Instruments
  - Inflation-Indexed Coupon Payment Private Sector Debt Instruments
  - Fixed and Floating Coupon Payment Private Lease Certificates

6.1.1. Government Domestic Debt Securities Risk Calculations

Government Domestic Debt Securities (GDDS) refers to the debt instruments issued in the domestic market by the Undersecretariat of Treasury. The obligor Government pays the amount it has indebted on the coupon payment dates and at the end of maturity to the holders of GDDS. Government Domestic Debt Securities can be traded by the persons and entities in the secondary markets throughout their terms.

Government Domestic Debt Securities can be classified from different perspectives according to their issuance method, the type of currency they have been issued, the types of their interest payment and whether they are a coupon-bearing bond or not.

6.1.1.1. Discounted Government Bonds

The discounted government bonds trading in Borsa Istanbul Debt Securities Market are the government bonds whose interest payment is at the end of maturity together with the principal amount. The quotation form of these bonds which have no interim coupon payment is return, and they are settled on the dirty price. Given the fact that there is only one cash flow throughout their term, the risk calculation shall be based on a single cash flow.

Let's assume that member A buys a discounted government bond with a nominal value of 10 million TL and a term to maturity of 1 year, by 12% simple interest. The settlement price of this transaction shall be $\frac{10.000.000}{(1+0,12*1)} = 8.928.571$ TL. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on day T and there will be a cash inflow on T+365.

Figure 6 - Discounted Government Bond Cash Flow Example

Table 4 - Discounted Government Bond Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 8.928.571 ₺	8.849.558 ₺	
Stressed NPV	- 8.928.571 ₺	8.695.652 ₺	
Initial Margin	- ₺	153.905 ₺	- 153.905 ₺
Variation Margin	- 8.928.571 ₺	8.849.558 ₺	- 79.014 ₺
		Total Margin	- 232.919 ₺

Because the settlement price in the example is 8.928.571 TL, and since the theoretical price is 8.849.558 TL, 79.014 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of cash are first calculated and the difference between them is found. Since the outflow date of the cash in the example is today, the stresses and unstressed net present values are equal to each other. In other words, there is no cash-based initial margin. Afterwards, the stresses and unstressed net present values of the security cash flows are calculated and the difference between them is found. While the unstressed net present value - theoretical price - in the example is 8.849.558 TL, the stressed net present value decreases to 8.695.652 TL. Because the risk scenario of this transaction is depreciation of the future value of cash, TL 153.905 difference between them is the security-based initial margin.

Because the settlement price in this buying transaction is less than the theoretical price, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 232.919 TL.

6.1.1.2. Fixed and Floating Coupon Payment Government Bonds

The fixed and floating coupon payment government bonds trading in Borsa Istanbul Debt Securities Market are government domestic debt securities whose interest payment is at the coupon periods and at the end of maturity together with the principal payment. The quotation of these bonds is made on the clean price, whereas their settlement is made on the dirty price. At what rate the floating coupon payment government bonds would distribute coupon at the coupon periods varies. In such type of securities whose next coupon payment rate is only specified, the coupon rate may be indexed to the inflation, exchange rate and interests formed in the auctions.

In performing the risk calculation of such type of securities in the Cash Flow Margining method, each of the coupon payments is addressed as a single cash flow. In assessing the cash flows of floating coupon payment government bonds whose coupon rate is unknown, it is assumed that the known next coupon rate would be distributed at all coupon periods. For example; for a floating coupon payment security which has 4 remaining coupon payments and whose next coupon rate is 5%, its risk calculation shall be made as if the remaining 4 coupon payments are also to be 5%. When the coupon payment of 5% is distributed and the next coupon rate is announced as 5.5%, the risk calculation shall be made as if the remaining 3 coupon payments are also to be 5.5%.

Let's assume that member A buys a fixed coupon payment government bond with a nominal value of 10 million TL, with 6% annual interest and making semiannual coupon payments, and with a term to maturity of 15 months, by 94 TL clean price with 1 day value. The accrued interest amount is 1,48 TL, and the settlement price of the transaction will be 94 + 1,48 = 95,48 TL. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and, since it is a fixed coupon payment security, there will be cash inflows on T+90, T+272 and T+454.

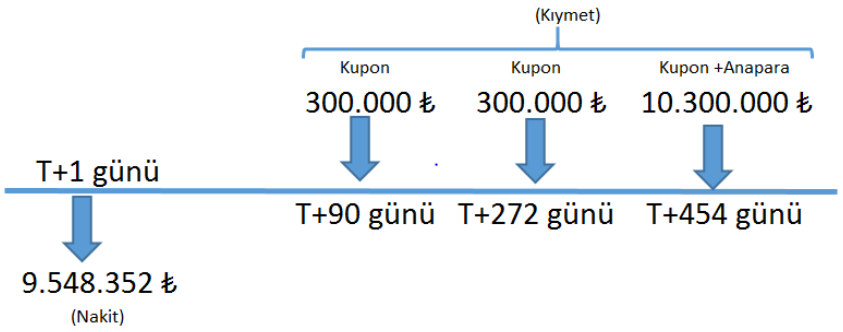


Figure 7 - Fixed and Floating Coupon Payment Government Bond Cash Flow Example

Table 5 - Fixed and Floating Coupon Payment Government Bond Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 9.545.097 ₺	9.512.095 ₺	
Stressed NPV	- 9.542.885 ₺	8.589.543 ₺	
Initial Margin	- 2.213 ₺	922.552 ₺	- 920.339 ₺
Variation Margin	- 9.545.097 ₺	9.512.095 ₺	- 33.003 ₺
		Total Margin	- 953.342 ₺

Because the settlement price of the transaction with T+1 value date in the example is 9.548.352 TL, the net present value of this amount at 13.25% discount rate shall be 9.545.097 TL. And since the theoretical price of the security is 9.512.095 TL, 33.003 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example,

the direction of the cash flows must be taken into account. Considering the cash inflows in the future and the cash outflow on the next day, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 9.542.885 TL and the net present value of the security decreases to 8.589.543 TL. After performing these transactions, the cash-based initial margin is 2.213 TL on credit and the security-based initial margin is 922.552 TL on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 920.339 TL.

Because the settlement price in this buying transaction is more than the theoretical price, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 953.342 TL.

For the floating coupon payable government bonds, the situation is not very different either. Let's change the assumptions of above example a little; and assume that member A has bought a floating coupon payment government bond with a nominal value of 10 million TL, a term to maturity of 15 months, making semiannual coupon payments where the next coupon rate is 3%, by paying 94 TL clean price with 1 day value. In that case, there shall be no difference in our risk calculation, and the results shall appear exactly the same. Further to the payment of 3% coupon after 90 days and setting of the subsequent coupon rate, the cash flows, hence the risk calculation, shall takes place over the new coupon rate.

6.1.1.3. Inflation-Indexed Coupon Payment Government Bonds

By guaranteeing a real return, the CPI-Indexed Government Bonds offer a different asset alternative to the investors. These bonds are investment instruments preferred by the investors because they provide a foreseeable and steady net return despite the changes in inflation. Eliminating the potential risks of inflation uncertainty on return, the CPI-Indexed Government Bonds also enable the investors to make investments for longer tenors. The principal payments of the bonds do not depreciate in any manner. Thus; while the purchasing power of an invested principal erodes in any fixed income investment instrument by the effect of inflation, not just the principal is nominally protected in CPI-Indexed Government Bonds but so does the purchasing power. In addition, the interests are also protected in the same manner. Whatever the inflation

level in the period to be elapsed until the maturity of CPI-Indexed Government Bonds is, the real return paid shall be fixed.

For all payments of the bond, the Consumer Price Index (CPI) published by the Turkish Statistical Institute (TSI) is used. Detailed explanations about CPI are available on TSI's website www.tuik.gov.tr.

At the redemption date, the inflation adjustment difference for the portion of the bond's principal amount exposed to the inflation shall be paid to the investor. Thus, a bond with a value of 100 TL shall not be affected in real terms from the inflation difference between its issue date and redemption date. Accordingly, the following formula is used for the inflation-adjusted principal payment to be made on the redemption date of a bond with a nominal value of 100 TL.

$$Principal\ Payment = \frac{Benchmark\ Index_{Redemption\ Date}}{Benchmark\ Index_{Issue\ Date}} * 100$$

The semiannual coupon payments are also protected against inflation like the principal. In this context, the coupon payments of a bond with a nominal value of 100 TL is calculated by the following formula.

$$Coupon\ Payment = \left(\frac{Benchmark\ Index_{Coupon\ Date}}{Benchmark\ Index_{Issue\ Date}} * 100\right) * Real\ Coupon\ Rate$$

The price quotations of CPI-Indexed Government Bonds are given on the clean price in which the accrued interest and inflation contribution are not included, as is announced by Borsa Istanbul. The settlement price, on the other hand, is on the dirty price outlined in the following formula.

$$Settlement\ Price = (Clean\ Price + Accrued\ Interest) * \frac{Benchmark\ Index_{Settlement\ Date}}{Benchmark\ Index_{Issue\ Date}}$$

In the risk calculation of these securities according to the Cash Flow Margining Model, the inflation haircut is taken as the most important factor. The inflation haircut-applied cash flows of the inflation-indexed securities subject to the settlement are determined. A haircut for the relevant security is calculated by dividing the benchmark index on the settlement date to the benchmark index on the issue date of the security and such haircut is applied to all cash flows. Then a risk calculation is made just like a bond with a fixed coupon payment.

Let's assume that on 25/12/2017, member A buys TRT200219T11 ISIN inflation-indexed government bond with a nominal value of 10 million TL, by 101 TL clean price with 1 day value. The reference index on the settlement date (26/12/2017) published on the Undersecretariat of Treasury is 319,138065, and the reference index on the issue date of the security is 228,8975. So, the inflation haircut of that security is $1{,}39424 = \frac{319{,}138065}{228{,}8975}$. Given 1,75% real interest rate of the security and 58 days to the coupon payment, the accrued interest occurs as 1,20 TL. In calculating the settlement price of the transaction, the accrued interest is added to the clean price and the resulting amount is multiplied by the inflation haircut, that is, the result appears as $(101 + 1{,}20) * 1{,}39424 = 142{,}49$ TL. The cash flows are determined in the manner that the adjusted coupon payments of the security with 1,75% real coupon payments will be $1{,}75\% * 1{,}39424 * 10\,000\,000 = 243.992$ TL and its adjusted principal payment will be $1{,}39424 * 10.000.000 = 13.942.401$ TL, and the risk calculation is made according to these cash flows. Because it is a selling transaction, there is a cash inflow on T+1 and, since it is an inflation-indexed coupon payment security, there will be cash outflows on T+58, T+240 and T+422.

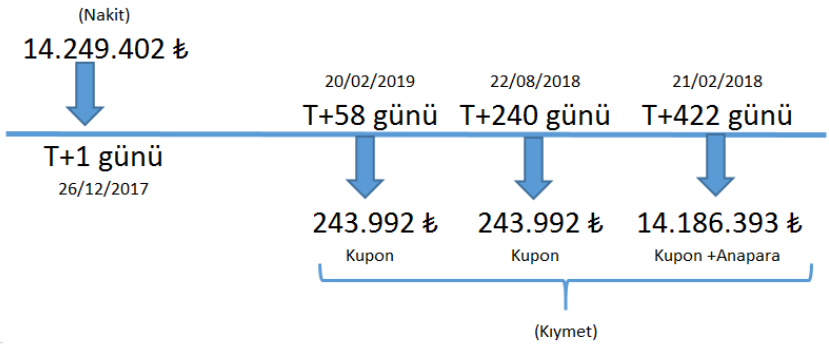


Figure 8 - Inflation-Indexed Coupon Payment Government Bond Cash Flow Example

Table 6 - Inflation-Indexed Coupon Payment Government Bond Risk Calculation Example

	Cash	Security	
Unstressed NPV	14.244.545 ₺	-14.269.709 ₺	
Stressed NPV	14.248.153 ₺	-16.024.447 ₺	
Initial Margin	- 3.608 ₺	1.754.738 ₺	-1.751.129 ₺
Variation Margin	14.244.545 ₺	-14.269.709 ₺	- 25.164 ₺
		Total Margin	-1.776.294 ₺

Because the settlement price of the transaction with T+1 value date in the example is 14.249.402 TL, the net present value of that amount at 13.25% discount rate shall be 14.244.545 TL. And since the theoretical price of the security is 14.269.709 TL, 25.164 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflows in the future and the cash inflow on the next day, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the cash increases to 14.248.153 TL and the net present value of the security increases to 16.024.447 TL. After performing these transactions, the cash-based initial margin is 3.608 TL on credit and the security-based initial margin is 1.754.738 TL on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 1.751.129 TL.

Because the net present value of the settlement price in this selling transaction is less than the theoretical price of the security, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 1.776.294 TL.

6.1.2. Government Lease Certificates Risk Calculation

A lease certificate is defined as a security which is issued by an asset lease company for the purpose of financing all type of assets and rights, and which enables its holders to get a proportionate share from the revenues generated from such assets or rights. In this definition, a right refers to any right backing the issuance of lease certificate, and an asset refers any asset other than such rights. Lease certificates can be issued by way of public offering, in the form of private placement or sales to qualified investors. Lease certificates can be issued by ALCs, by backing them by either one or a combination of the following:

- Ownership,
- Management contract,
- Trade,
- Partnership,
- Contract on a work of art

Lease certificates backed by ownership are issued to provide financing for the rights and assets to be taken over by the ALC from the originator for being sublet to the originator or third parties or managed on behalf of the ALC.

Lease certificates backed by a management contract are issued to transfer to the ALC in accordance with the provisions of the contract, the proceeds generated as a result of the management, including the subletting, of the assets or rights of the originator in favor of the ALC.

Lease certificates backed by a trade are issued to finance the acquisition of an asset or right in case of a transaction where the ALC purchases such asset or right and sells it on deferred basis to the companies with specific qualifications.

Lease certificates backed by partnership are issued to enable the ALC to become a partner to the joint venture.

Lease certificates backed by a contract on a work of art are issued to finance the creation of a work of art, as part of a work of art contract to which the ALC is party in its capacity as the owner of such work.

6.1.2.1. Fixed Lease Payment Government Lease Certificates

The fixed lease payment lease certificates trading in Borsa Istanbul Debt Securities Market are lease certificates issued by the Undersecretariat of Treasury Asset Leasing Company, whose lease payment is at the lease periods and at the end of maturity together with the principal payment. The quotation of these certificates is made on the clean price, whereas their settlement is made on the dirty price. At what rate the fixed lease payment lease certificates would distribute lease at the lease periods is known.

In performing the risk calculation of such type of securities in the Cash Flow Margining method, each of the lease payments is addressed as a single cash flow. After the cash flow table of these securities is determined, the risk management system runs in the same manner as it runs for the fixed coupon payment government bonds. Although the nature of paid amounts at such two different types of coupon/lease periods is not the same, they mathematically account to the same thing when cash inflowing to and outflowing from the account is considered.

Let's assume that member A sells a fixed lease payment lease certificate with a nominal value of 10 million TL, at 10.72% annual interest making semiannual lease payments and with a term to maturity of 468 days, by 100 TL clean price with 2 day value. The accrued interest amount is 2,3TL, and the settlement price of the transaction will be 100 + 2,3 = 102,3 TL. The schematic illustration of the cash flow table shall be as follows. Because it is a selling transaction, there is a cash inflow on T+2 and, since it is a fixed lease payment security, there will be cash outflows on T+104, T+286 and T+468.

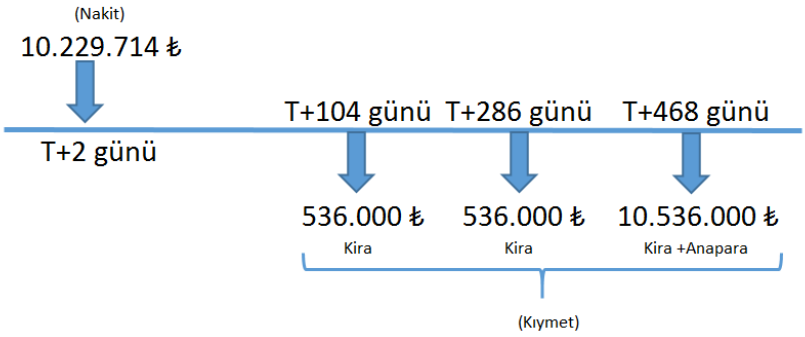


Figure 9 - Fixed Lease Payment Lease Certificate Cash Flow Example

Table 7 - Fixed Lease Payment Lease Certificate Risk Calculation Example

	Cash	Security	
Unstressed NPV	10.222.767 ₺	-10.150.946 ₺	
Stressed NPV	10.227.949 ₺	-11.361.736 ₺	
Initial Margin	- 5.182 ₺	1.210.789 ₺	- 1.205.607 ₺
Variation Margin	10.222.767 ₺	-10.150.946 ₺	71.820 ₺
		Total Margin	- 1.133.787 ₺

Because the settlement price of the transaction with T+2 value in the example is 10.229.714 TL, the net present value of this amount by 13.2% discount rate shall be 10.222.767 TL. And since the theoretical price of the security is 10.150.946 TL, 71.820 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflows in the

future and the cash inflow after 2 days, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the cash increases to 10.227.949 TL and the net present value of the security increases to 11.361.736 TL. After performing these transactions, the cash-based initial margin is 5.182 TL on credit and the security-based initial margin is 1.210.789 TL on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 1.205.607 TL.

Because the net present value of the settlement price in this selling transaction is more than the theoretical price of the security, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 1.133.787 TL.

6.1.2.2. Inflation-Indexed Lease Payment Government Lease Certificates

The inflation-indexed lease payment government lease certificates trading in Borsa Istanbul Debt Securities Market are lease certificates issued by the Undersecretariat of Treasury Asset Leasing Company, whose lease payment is at the lease periods and at the end of maturity together with the principal payment. Unlike the fixed lease payment lease certificates, these securities make a real lease payment. At the redemption date and lease periods, the inflation adjustment difference for the portion of the bond's principal amount and lease values exposed to the inflation shall be paid to the investor. Thus, a bond with a value of 100 TL shall not be affected in real terms from the inflation difference between its issue date and redemption date. The quotation of these bonds is made on the clean price, whereas their settlement is made on the dirty price.

In the risk calculation of these securities according to the Cash Flow Margining Model, the inflation haircut is taken as the most important factor. The inflation haircut-applied cash flows of the inflation-indexed securities subject to the settlement are determined. A haircut for the relevant security is calculated by dividing the benchmark index on the settlement date to the benchmark index on the issue date of the security and such haircut is applied to all cash flows. Then a risk calculation is made just like a lease certificate with a fixed lease payment. As is seen, the risk management method similarity between the fixed lease payment lease certificates and the fixed income government bonds is also applicable here. The key factor in the Cash Flow Margining Method is not the nature of incoming and outgoing cash flows but the size and yield

rates. Although the cash inflows and outflows of the inflation-indexed government bonds are defined as interest and those of the inflation-indexed lease certificates are defined as lease herein, the risk management system defines them in either case as cash flow. Hence, no difference occur in the conducted process after determining the amounts of the interest or lease payments.

6.1.2.3. Fixed Lease Payment Government Lease Certificates Issued Abroad

The fixed lease payment government lease certificates issued abroad being traded in Borsa Istanbul Debt Securities Market are lease certificates issued by the Undersecretariat of Treasury Asset Leasing Company, whose lease payment is at the lease periods and at the end of maturity together with the principal payment. The quotation of these bonds is made on the clean price, whereas their settlement is made on the dirty price. At what rate the fixed lease payment lease certificates issued abroad would distribute lease at the lease periods is known.

In performing the risk calculation of such type of securities in the Cash Flow Margining method, each of the lease payments is addressed as a single cash flow. After the cash flow table of these securities is determined, the risk management system runs in the same manner as it runs for the fixed coupon payment government bonds. Although the nature of paid amounts at such two different types of coupon/lease periods is not the same, they mathematically account to the same thing when the cash inflowing to and outflowing from the account is considered.

What differs here is the currency of the security and hence, the yield curve used in conducting the risk calculation. Because these securities are issued in a currency other than TL, a currency-specific yield curve must be designed. Various yield curves that can be dependent on the type, issuer and currency of the security and other parameters are drawn and monitored on a daily basis. In performing the risk calculation, the returns in the yield curve to which the security is associated are also taken into account and the discounts are made accordingly.

Let’s assume that member A buys a fixed lease payment lease certificate issued abroad with a nominal value of 10 million $, at 4,557% annual interest, making semiannual lease payments and with a term to maturity of 514 days, by 103 $ clean price with 1 day value. The accrued interest amount is 0,4 $, and the settlement price of the transaction will be 103 + 0,4 = 103,4 $. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and, since it is a fixed lease payment security, there will be cash inflows on T+150, T+332 and T+514.

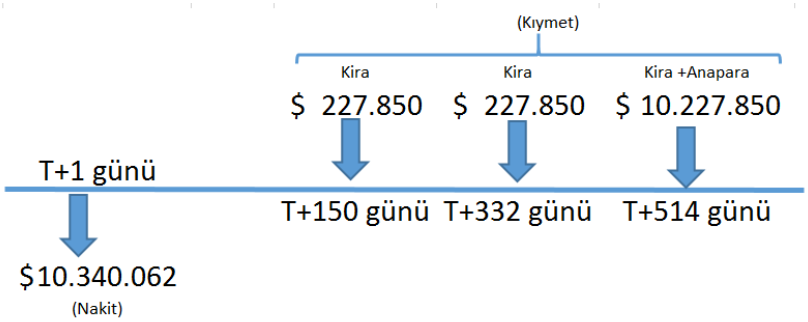


Figure 10 - Fixed Lease Payment Lease Certificate Issued Abroad Cash Flow Example

Table 8 - Fixed Lease Payment Lease Certificate Issued Abroad Risk Calculation Example

	Cash	Security	
Unstressed NPV	$(10.339.640)	$ 10.341.572	
Stressed NPV	$(10.338.278)	$ 9.689.628	
Initial Margin	$ (1.362)	$ 651.944	$ (650.581)
Variation Margin	$(10.339.640)	$ 10.341.572	$ 1.932
		Total Margin	$ (648.650)

Because the settlement price of the transaction with T+1 value date in the example is 10.340.062 $, the net present value of this amount by 1.5% discount rate shall be 10.339.640 $. And since the theoretical price of the security is 10.341.572 $, 1.932 $ difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflows in the future and the cash outflow on the next day, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 10.338.278 $ and the net present value of the security decreases to 9.689.628 $. After performing these transactions, the cash-based initial margin is 1.362 $ on credit, and the security-based initial margin is 651.944 $ on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 650.581 $.

Because the net present value of the settlement price in this buying transaction is less than the theoretical price of the security, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 648.650 $.

6.1.3. Stripped Forms of Coupon/Lease Payment Government Domestic Debt Securities

Separating the principal and proceeds of securities and trading them separately is called "stripping" (Separate Trading of Registered Interest and Principal of Securities) operation. Should a stripping operation be performed to make the principle and proceeds of Government Domestic Debt Securities eligible for trading separately, each coupon and principal made subject to the stripping operation shall individually be qualified as security. Having different quotations depending on their type, each of these securities has a single cash flow and they resemble to the discounted government bonds with respect to their risk management mechanism.

6.1.3.1. Stripped Coupons/Leases of Coupon/Lease Payment Government Domestic Debt Securities

Stripped coupons and leases traded in Borsa Istanbul Debt Securities Market are securities which have no coupon/lease payment until the redemption date but have payment up to a coupon/lease amount on the redemption date. Their quotation and settlement are made on the dirty price. Given the fact that there is only one cash flow throughout their term, the risk calculation shall also be performed on a single cash flow.

The amount that the coupons/leases stripped from the fixed coupon/lease payment securities will pay at their maturity is known. On the other hand, the amount to be paid by the coupons/leases stripped from the floating coupon payment securities at their maturity varies. While the amount to be paid at the redemption by the coupon closest to maturity out of the stripped ones is known, it must be entered in the relevant coupon period to be able to know others. Accordingly, in determining the cash flows used in the risk management system, the calculations are made by assuming that the amount to be paid by the coupon closest to maturity shall also be paid by other coupons. Upon any change in the coupon value, the cash flows in the risk management system shall also update themselves automatically.

The amount to be paid by the coupons/leases stripped from the inflation-indexed securities at their maturity is also unknown. The amount to be calculated by multiplying the real

rate of return known at the issuance by the inflation haircut shall be the amount to be paid by the security at its maturity date.

Let's assume that member A buys the stripped coupon of a fixed coupon government bond with a nominal value of 10 million TL, paying 4% coupon at each period and with a term to maturity of 50 days, by 3,93 TL with 1 day value. The total amount arising from this transaction to be paid on settlement date shall be 393.000 TL. And the schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and there will be a cash inflow on T+50.

Figure 11 - Stripped Coupon/Lease Cash Flow Example

Table 9 - Stripped Coupon/Lease Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 392.866 ₺	393.359 ₺	
Stressed NPV	- 392.775 ₺	388.708 ₺	
Initial Margin	- 91 ₺	4.651 ₺	- 4.560 ₺
Variation Margin	- 392.866 ₺	393.359 ₺	493 ₺
		Total Margin	- 4.067 ₺

Because the settlement price of the transaction with T+1 value date in the example is 393.000 TL, the net present value of this amount at 13.25% discount rate shall be 392.866 TL. And since the theoretical price of the security is 393.359 TL, 493 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflows in the future and the cash outflows on the next day, the risk scenario is a rise in interest rates. When the

risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 392.775 TL and the net present value of the security decreases to 388.708 TL. After performing these transactions, the cash-based initial margin is 91 TL on credit and the security-based initial margin is 4.651 TL on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 4.560 TL.

Because the net present value of the settlement price in this buying transaction is less than the theoretical price of the security, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 4.067 TL.

6.1.3.2. Stripped Principals of Coupon/Lease Payment Government Domestic Debt Securities

Stripped principals traded in Borsa Istanbul Debt Securities Market are securities which have no coupon/lease payment until the redemption date but have payment up to the principal amount on the redemption date. The quotation of stripped principles other than those of inflation-indexed securities is simple interest, and their settlement is made on the dirty price. On the other hand, the stripped principles of inflation-indexed securities are quoted on the dirty price and their settlement is made on the dirty price. Given the fact that there is only one cash flow throughout their term, the risk calculation shall be based on a single cash flow.

Except for the stripped principles of inflation-indexed securities, the amount that the stripped principles will pay at their maturity is known. The amount to be paid by the stripped principles of inflation-indexed securities at their maturity shall be the amount to be calculated by multiplying the principal amount known at the issuance by the inflation haircut.

Let's assume that member A sells the stripped principal of a fixed coupon government bond with a nominal value of 10 million TL and a term to maturity of 800 days, at 12.25% simple interest with 2 day value. The settlement price of this transaction shall be $\frac{10.000.000}{(1+0,1225*\frac{798}{365})} =$ 7.887.543 TL . Nakit akış tablosunun şematize edilmiş hali de aşağıdaki gibi olacaktır. Because it is a selling transaction, there is a cash inflow on T+2, and there will be a cash inflow on T+800.

Figure 12 - Stripped Principal Cash Flow Example

Table 10 - Stripped Principal Risk Calculation Example

	Cash	Security	
Unstressed NPV	7.882.186 ₺	- 7.877.417 ₺	
Stressed NPV	7.886.182 ₺	- 9.332.911 ₺	
Initial Margin	- 3.996 ₺	1.455.493 ₺	- 1.451.498 ₺
Variation Margin	7.882.186 ₺	- 7.877.417 ₺	4.769 ₺
		Total Margin	- 1.446.729 ₺

Because the settlement price of the transaction with T+2 value in the example is 7.887.543 TL, the net present value of this amount by 13.2% discount rate shall be 7.882.186 TL. And since the theoretical price of the security by 11.5% discount rate is 7.877.417 TL, 4.769 TL difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflows in the future and the cash outflows on the next day, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the cash increases to 7.886.182 TL and the net present value of the security increases to 9.332.911 TL. After performing these transactions, the cash-based initial margin is 3.996 TL on credit and the security-based initial margin is 1.455.493 TL on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Thus, the initial margin is found as 1.451.498 TL.

Because the net present value of the settlement price in this selling transaction is more than the theoretical price, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 1.446.729 TL.

6.1.4. Euro Government Bonds (Eurobond)

Eurobonds are generally bearer bonds issued in a currency other than that of the issuer's home country, simultaneously in several countries by a bank and/or a syndication through an international consortium. As a suitable investment instrument for those wishing to make long-term investment in a foreign currency, Eurobonds are typically long-term debt instruments offered in foreign currency by the governments or companies in the international markets for raising funds outside of their home country. The Republic of Turkey Undersecretariat of Treasury generally issues USD or EUR denominated Eurobonds in the international markets.

Eurobonds typically have a term of 5 to 30 years. As a long-term bond, they are issued with coupon. The coupons generally have a fixed interest and provide a regular cash flow to the investors at the coupon payment periods. The principal and coupon payments are made in the currency in which they are issued. USD-denominated bonds have semi-annual coupon payments and EUR-denominated bonds have annual coupon payments. The coupons' interest rates are expressed as annual simple interest. They can be liquidated before their maturity in accordance with the market conditions.

Let's assume that member A buys a fixed coupon payment Eurobond with a nominal value of 10 million €, at 3.25% annual interest with a single coupon payment annually and a term to maturity of 1010 days, by 102.5 € clean price with 1 day value. The accrued interest amount is 0,85 €, and the settlement price of the transaction will be 102,5+0,85=103,35 €. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and, since it is a fixed coupon payment security, there will be a cash inflow on T+280, T+645 and T+1010.

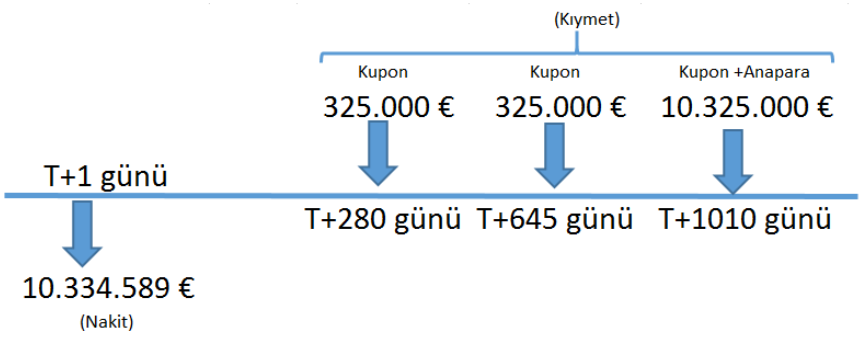


Figure 13 - Eurobond Cash Flow Example

Table 11 - Eurobond Risk Calculation Example

	Cash	Security	
Unstressed NPV	-10.334.251 €	10.311.574 €	
Stressed NPV	-10.332.886 €	9.101.663 €	
Initial Margin	- 1.365 €	1.209.910 €	- 1.208.545 €
Variation Margin	-10.334.251 €	10.311.574 €	- 22.678 €
		Total Margin	- 1.231.223 €

Because the settlement price of the transaction with T+1 value date in the example is 10.334.589 €, the net present value of this amount by 1.2% discount rate shall be 10.334.251 €. And since the theoretical price of the security is 10.331.574 €, 22.678 € difference between them makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflows in the future and the cash outflow on the next day, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 10.332.886 € and the net present value of the security decreases to 9.101.663 €. After performing these transactions, the cash-based initial margin is 1.365 € on credit and the security-based initial margin is 1.209.910 € on risk. In other words, when this risk scenario is applied, the difference on the cash side is a factor reducing the initial margin. Hence, the initial margin is found as 1.208.545 €.

Because the net present value of the settlement price in this buying transaction is more than the theoretical price of the security, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 1.231.223 €.

6.1.5. Private Sector Debt Instruments

Bonds are debt securities issued with a term of minimum 1 year and longer by the government or joint stock companies for borrowing purposes. The debt securities issued by the joint stock companies with a term longer than 1 year are called "private sector bonds". Their terms can be set freely and they can be issued with a fixed or floating interest. They are generally offered through a consortium comprising of one or more than one brokerage house.

The most important factors effecting the yields of bonds are their liquidity and the risk they bear. Since the corporate bonds bear higher risks than the government bonds by taking account of the bankruptcy of the company and its default in the interest and principal payments, they generally provide a higher interest income compared to the government bonds. Given the fact that the debts are paid first in case of bankruptcy or liquidation of a company, the bond holders shall get their receivables before the company partners (stakeholders).

The bond issues, except for the government debt securities, are subject to the regulations of the Capital Markets Board. They can be sold by public offering but can also be sold to the qualified investors without public offering.

Commercial papers are debt securities issued at a discount by the issuers in their capacity as borrower in accordance with the regulation of the Capital Markets Boards to raise short-term debt. The tenor of commercial papers cannot be longer than 1 year. Commercial papers are sold at a discounted price calculated by using the term-compatible discount rates designated by the issuer. The term-compatible discount rates to be applied in the placement of commercial papers offered for sale through public offering are calculated on an annual basis and announced within the placement period by the issuer at the locations where the offering would take place.

Bank Papers are securities issued by the banks in their capacity as borrower in accordance with the regulations of the Capital Markets Board to raise funds. These papers are offered at a discount basis and their discount rates are freely set by the issuer bank. The tenor of the bank papers to be offered to public cannot be shorter than 60 days and longer than 1 year. The term-

compatible discount rates to be applied in the placement of bank papers offered for sale through public offering are calculated on an annual basis and announced within the placement period by the bank at the locations where the offering would take place.

Asset and mortgage-covered securities are capital market instruments in nature of debt instruments, which are general obligations of the issuer and covered by the assets in the collateral pool. They can be issued in two different ways: Asset-Covered Securities (ACS) and Mortgage-Covered Securities (MCS).

The Asset-Covered Securities are capital market instruments in nature of debt instruments issued by the mortgage finance institutions, leasing companies, finance companies, factoring companies, real estate investment trusts and the public entities and institutions authorized to issue securities pursuant to their regulations, by way of securing them with the assets in the collateral pool.

On the other hand, the Mortgage-Covered Securities can only be issued by the housing finance institutions (HFI) and the mortgage finance institutions (MFI). Housing finance institutions refer to the banks extending credit or providing leasing facility directly to the consumer within the scope of housing finance and to the leasing and finance companies found eligible to engage in housing finance activities by the BRSA. Mortgage finance institutions are corporations established for the purpose of acquiring the assets, transferring the assets, managing the acquired assets and for performing the activities by taking the assets as collateral. Such securities cannot be used for any purpose other than the collateral purpose, they cannot be pledged nor can be provided as collateral, cannot be seized including the aim of collecting the public receivables and cannot be included in the bankruptcy estate and no provisional injunction decision can be issued until their redemption even if the management or supervision of the issuer is taken over by the public institutions. Mortgage-Covered Securities can be sold by way of public offering but can also be issued in the form of private placement or sales to qualified investors.

Asset-Backed Securities (ABS) are securities issued against the assets to be taken over by the asset finance fund (AFF) or mortgage finance institutions (MFI). AFF refers to the non-legal personality estate which has been established by the proceeds collected against the asset-backed securities in favor of the holders of ABS in accordance with the fund bylaws. A mortgage finance

institution (MFI) refers to the corporation established for the purpose of acquiring the assets, transferring the assets, managing the acquired assets and for performing the activities by taking the assets as collateral.

Mortgage-Backed Securities (MBS) are securities issued against the assets to be taken over by the housing finance fund (HFF) or mortgage finance institutions (MFI).

Private Lease Certificates are securities issued for the purpose of financing the assets taken over by way of acquisition or leasing by the private sector asset leasing companies in their name and for and on behalf of the certificate holders, which enable their holders to become a beneficiary pro-rata to their shares of the proceeds generated from such assets.

All of these private sector debt instruments are analyzed in the risk management system according to the coupons or leases they distribute.

6.1.5.1. Discounted Private Sector Debt Instruments

Let's assume that member A buys a discounted commercial paper with a nominal value of 10 million TL and a term to maturity of 100 days, at 14.6% simple interest with T+1 value. The settlement price of the transaction will be $\frac{10.000.000}{(1+0{,}146*\frac{99}{365})} = 9.619.084$ TL. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and there will be a cash inflow on T+100.

Figure 14 - Discounted PSDI Cash Flow Example

Table 12 - Discounted PSDI Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 9.615.806 ₺	9.616.091 ₺	
Stressed NPV	- 9.618.241 ₺	9.399.551 ₺	
Initial Margin	2.436 ₺	216.540 ₺	- 218.975 ₺
Variation Margin	- 9.615.806 ₺	9.616.091 ₺	285 ₺

Total Margin	- 218.690 ₺

Because the settlement price of the transaction with T+1 value date in the example is 9.619.084 TL, the net present value of this amount at 13.25% discount rate shall be 9.615.806 TL. And since the theoretical price of the security by 15.36% discount rate is 9.616.091 TL, 285TL difference between them makes up the variation margin

In that process, the rate of return used for discounting the cash flows of the security and the rate of return used for discounting the cash are generated from different yield curves. This is because TL-denominated cash is always discounted by the yield curves derived from the securities issued by the Undersecretariat of Treasury. In other words, the cash flows of the security in this example are discounted by the yield curve derived from the prices of the financial private sector bonds, whereas its cash portion is discounted by the yield curve derived from the securities issued by the Undersecretariat of Treasury.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account on the basis of the yield curve being used. While the risk scenario is a fall in interest rates at the yield curve section used for the cash portion, the risk scenario used for the yield curve on the security portion must be a rise in interest rates. When the stresses are applied in such directions, the net present value of cash increases to 9.618.241 TL and the net present value of security decreases to 9.399.551 TL. After performing these transactions, the cash-based initial margin is 2.436 TL on credit and the security-based initial margin is 216.540 TL on risk. Thus, the initial margin is found as 218.975 TL.

Because the settlement price in this buying transaction is less than the theoretical price, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 218.690 TL.

6.1.5.2. Fixed and Floating Coupon Private Sector Debt Instruments

Let’s assume that member A buys a fixed coupon payment private sector bond with a nominal value of 10 million TL, at 15,08% annual interest, making semiannual coupon payments and with a term to maturity of 511 days, by 99.5 TL clean price with 1 day value. The accrued interest amount is 1,45 TL, and the settlement price of the transaction will be 99,5 + 1,45 =

100,95 TL. The schematic illustration of the cash flow table shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and, since it is a fixed coupon payment security, there will be cash inflows on T+147, T+329 and T+511.

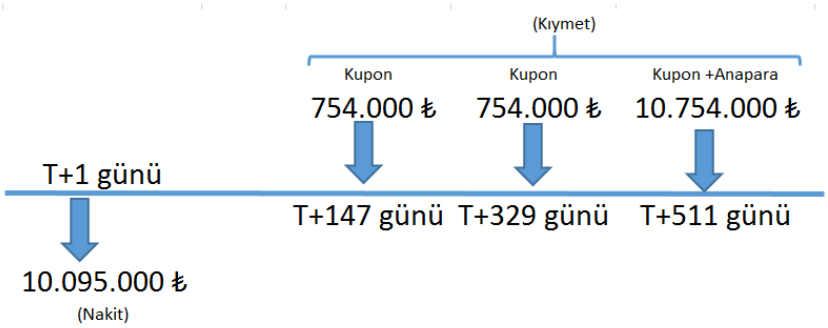


Figure 15 - Fixed and Floating PSDI Cash Flow Example

Table 13 - Fixed and Floating PSDI Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 10.091.559 ₺	10.115.164 ₺	
Stressed NPV	- 10.094.115 ₺	9.105.006 ₺	
Initial Margin	2.556 ₺	1.010.157 ₺	- 1.012.714 ₺
Variation Margin	- 10.091.559 ₺	10.115.164 ₺	23.605 ₺
		Total Margin	- 989.109 ₺

Because the settlement price of the transaction with T+1 value date in the example is 10.095.000 TL, the net present value of this amount at 13.25% discount rate shall be 10.091.559 TL. And since the theoretical price of the security is 10.115.164TL, 23.605 TL difference between them makes up the variation margin.

In that process, the rate of return used for discounting the cash flows of the security and the rate of return used for discounting the cash are generated from different yield curves. This is because TL-denominated cash is always discounted by the yield curves derived from the securities issued by the Undersecretariat of Treasury. In other words, the cash flows of the security in this example are discounted by the yield curve derived from the prices of the financial private sector bonds, whereas its cash portion is discounted by the yield curve derived from the securities issued by the Undersecretariat of Treasury.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account on the basis of the yield curve being used. While the risk scenario is a fall in interest rates at the yield curve section used for the cash portion, the risk scenario used for the yield curve on the security portion must be a rise in interest rates. When the stresses are applied in such directions, the net present value of cash increases to 10.094.115 TL and the net present value of security decreases to 9.105.006 TL. After performing these transactions, the cash-based initial margin with risk is 2.556 TL and the security-based initial margin with risk is 1.010.157 TL. Thus, the initial margin is found as 1.012.714 TL.

Because the settlement price in this buying transaction is less than the theoretical price, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 989.109 TL.

For the floating coupon payable private sector debt instruments, the situation is not very different either. Let's change the assumptions of above example a little; and assume that member A has bought a floating coupon payment government bond with a nominal value of 10 million TL and a term to maturity of 511 days, making semiannual coupon payments where the next coupon rate is 7,54%, by 99,5 TL clean price with 1 day value. In that case, there shall be no difference in our risk calculation, and the results shall appear exactly the same. Further to the payment of 7.54% coupon after 147 days and setting of the subsequent coupon rate, the cash flows, hence the risk calculation, shall takes place over the new coupon rate.

6.1.5.3. Inflation-Indexed Coupon Payment Private Sector Debt Instruments

When the risk calculation of the inflation indexed coupon payment private sector debt instruments, the methodology used in the inflation indexed coupon payment government bonds that we have explained in the previous section is employed. The key criterion is the inflation haircut generated by the benchmark indices published by the Undersecretariat of Treasury, and the net present values of the coupons and principal are calculated after such haircut is applied.

Let's assume that member A sells an inflation indexed private sector debt instrument with a nominal value of 10 million TL and a term to maturity of 400 days, by 102 TL clean price with 2 day value. Assuming that the inflation haircut of such security is 1,3, its periodic real interest

rate is 2% and has a term to coupon payment of 36 days, the accrued interest occurs as 1,63 TL. In calculating the settlement price of the transaction, the accrued interest is added to the clean price and the resulting amount is multiplied by the inflation haircut, that is, the result appears as $(102 + 1{,}63) * 1{,}3 = 134{,}71$ TL. The cash flows are determined in the manner that the adjusted coupon payments of the security with 2% real coupon payments will be $2\% * 1{,}3 * 10\,000\,000 = 260.000$ TL and its adjusted principal payment will be $1{,}3 * 10\,000\,000 = 13.000.000$ TL, and the risk calculation is made according to these cash flows. Because it is a selling transaction, there is a cash inflow on T+2 and, since it is an inflation-indexed coupon payment security, there will be cash outflows on T+36, T+218 and T+400.

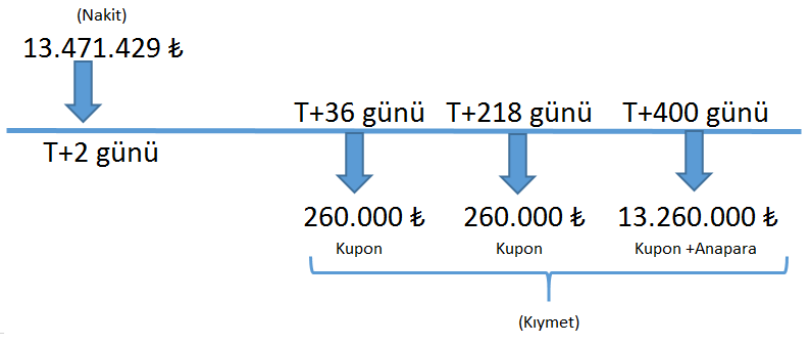


Figure 16 - Inflation Indexed Coupon Payment PSDI Cash Flow Example

Table 14 - Inflation Indexed Coupon Payment PSDI Risk Calculation Example

	Cash	Security	
Unstressed NPV	13.462.247 ₺	-13.421.079 ₺	
Stressed NPV	13.456.007 ₺	-14.974.667 ₺	
Initial Margin	6.240 ₺	1.553.588 ₺	- 1.559.829 ₺
Variation Margin	13.462.247 ₺	-13.421.079 ₺	41.168 ₺
		Total Margin	- 1.518.661 ₺

Because the settlement price of the transaction with T+2 value in the example is 13.471.429 TL, the net present value of this amount at 13.25% discount rate shall be 13.462.247 TL. And since the theoretical price of the security is 13.421.079 TL, 41.168 TL difference between them makes up the variation margin.

In that process, the rate of return used for discounting the cash flows of the security and the rate of return used for discounting the cash are generated from different yield curves. This is because TL-denominated cash is always discounted by the yield curves derived from the

securities issued by the Undersecretariat of Treasury. In other words, the cash flows of the security in this example are discounted by the yield curve derived from the prices of the inflation-indexed private sector bonds, whereas its cash portion is discounted by the yield curve derived from the securities issued by the Undersecretariat of Treasury.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account on the basis of the yield curve being used. While the risk scenario is a rise in interest rates at the yield curve section used for the cash portion, the risk scenario used for the yield curve on the security portion must be a fall in interest rates. When the stresses are applied in such directions, the net present value of cash decreases to 13.456.007 TL and the net present value of security increases to 14.974.667 TL. After performing these transactions, the cash-based initial margin is 6.240 TL on credit and the security-based initial margin is 1.553.588 TL on risk. Thus, the initial margin is found as 1.559.829 TL.

Because the net present value of the settlement price in this selling transaction is more than the theoretical price of the security, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 1.518.661 TL.

6.1.5.4. Fixed and Floating Coupon Payment Private Lease Certificates

In performing the risk calculation of such type of securities in the Cash Flow Margining method, each of the lease payments is addressed as a single cash flow. After the cash flow table of these securities is determined, the risk management system runs in the same manner as it runs for the fixed coupon payment private sector bonds. Although the nature of paid amounts at such two different types of coupon/lease periods is not the same, they mathematically account to the same thing when the cash inflowing to and outflowing from the account is considered.

Let’s assume that member A sells a fixed lease payment private lease certificate with a nominal value of 10 million TL, at 10% annual interest with quarterly coupon payment, and a term to maturity of 441 days, by 95 TL clean price with 3 day value. The accrued interest amount is 0,38 TL, and the settlement price of the transaction will be 95+0,38=95,38 TL. The schematic illustration of the cash flow table shall be as follows. Because it is a selling transaction, there is a

cash inflow on T+3 and, since it is a fixed coupon payment security, there will be cash outflows on T+77, T+168, T+259, T+350 and T+441.

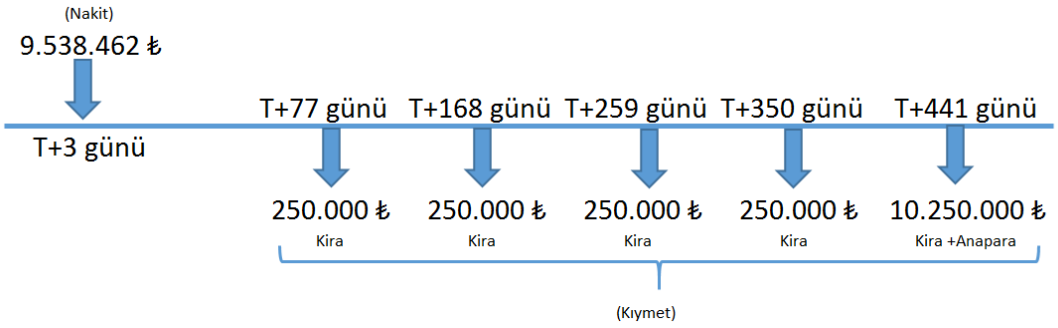


Figure 17 - Fixed and Floating Coupon Payment Private Lease Certificates Cash Flow Example

Table 15 - Fixed and Floating Coupon Payment Private Lease Certificates Risk Calculation Example

	Cash	Security	
Unstressed NPV	9.528.781 ₺	- 9.510.920 ₺	
Stressed NPV	9.522.150 ₺	- 10.549.666 ₺	
Initial Margin	6.630 ₺	1.038.745 ₺	- 1.045.376 ₺
Variation Margin	9.528.781 ₺	- 9.510.920 ₺	17.861 ₺
		Total Margin	- 1.027.515 ₺

Because the settlement price of the transaction with T+3 value date in the example is 9.538.462 TL, the net present value of this amount by 13.15% discount rate shall be 9.528.781 TL. And since the theoretical price of the security is 9.510.920 TL, 17.861 TL difference between them makes up the variation margin.

In that process, the rate of return used for discounting the cash flows of the security and the rate of return used for discounting the cash are generated from different yield curves. This is because TL-denominated cash is always discounted by the yield curves derived from the securities issued by the Undersecretariat of Treasury. In other words, the cash flows of the security in this example are discounted by the yield curve derived from the prices of the private sector lease certificates, whereas its cash portion is discounted by the yield curve derived from the securities issued by the Undersecretariat of Treasury.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the

difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account on the basis of the yield curve being used. While the risk scenario is a rise in interest rates at the yield curve section used for the cash portion, the risk scenario used for the yield curve on the security portion must be a fall in interest rates. When the stresses are applied in such directions, the net present value of cash decreases to 9.522.150 TL and the net present value of security increases to 10.549.666 TL. After performing these transactions, the cash-based initial margin with risk is 6.630 TL and the security-based initial margin with risk is 1.038.745 TL. Thus, the initial margin is found as 1.045.376 TL.

Because the net present value of the settlement price in this selling transaction is more than the theoretical price of the security, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 1.027.515 TL.

For the floating coupon payable private lease certificates, the situation is not very different either. Let's change the assumptions of above example a little; and assume that member A has sold a floating coupon payment private lease certificate with a nominal value of 10 million TL and a term to maturity of 441 days, making quarterly coupon payments where the next coupon rate is 2,5%, by 95 TL clean price with 3 day value. In that case, there shall be no difference in our risk calculation, and the results shall appear exactly the same. Further to the payment of 2,5% coupon after 77 days and setting of the subsequent coupon rate, the cash flows, hence the risk calculation, shall takes place over the new coupon rate.

6.2. (Repo-Reverse Repo Market) - (Interbank Repo-Reverse Repo Market)

In these markets operating to ensure secure execution within the organized market conditions of the sale of fixed income securities with a promise to buy them back and their purchase with a promise to sell them back, the definition (ISIN code) of the security subject to the transaction is not indicated during the order entry.

The party engaging in a repo makes the security allocation until 15:00 on the value date in a manner to be 5 different securities at most. The repo allocation prices used during such allocation are calculated at the end of each day as to be used for the next day and announced to the members by Takasbank. Takasbank is entitled to change, within the day, the repo allocation prices it has published on the previous day. Upon execution of the settlement in the first leg of the repo transaction, in other words, when the repo party presents the security and the reverse-repo

party provides the cash, the securities presented against the transaction are kept in a blocked account on behalf of the reverse-repo member until the value date 2 and not delivered to the reverse-repo member.

Table 16 - Functioning of Repo-Reverse Repo and Interbank Repo Market

	Ters Repocu	Repocu
V1	- İşlem tutarını öder - Repocunun verdiği menkul kıymetler, bloke hesabında tutulur	- İşlem karşılığı teslim edeceği menkul kıymetin tanım ve tutarını Borsa'ya bildirir - Menkul kıymetleri teslim eder - Ters repocunun ödediği tutar hesabına geçer
V2	- Anapara+faiz-stopaj tutarı hesabına geçilir.	- Anapara+faiz tutarını öder - Menkul kıymetler serbest deposuna geçer - Stopaj tutarını ters repocu adına vergi dairesine yatırır

The only difference of the interbank reverse-repo market from the standard repo-reverse repo market is that only the member banks are able to trade in the interbank repo market. All other transactions are same in both of the markets.

In the risk calculation according to the Cash Flow Margining Model, the process in these repo markets is divided into three phases and the risk calculation differs at these phases.

- 1st phase: between the trade time and the repo securities allocation time (15:00 on value date)
- 2nd phase: between the repo securities allocation time (15:00 on value date) and the completion of settlement of the repo's first leg.
- 3rd phase: between the completion of settlement of the repo's first leg and the completion of settlement of the repo's second leg.

Given the cash flows of the repo member and reverse-repo member at the first phase of the transaction, since the security subject to the transaction is not known yet, the future cash flows of such security are also not known under the normal conditions. Thus, the risk calculation is conducted based on the assumption that a synthetic 2 years zero-coupon bond defined to the

system for such situation would be made subject to the repo transaction. When the repo member's 1st phase cash flows schematized below are analyzed; the net present values of the synthetic security's cash flows are netting-off each other and hence, the presence of synthetic security does not change the total risk value at all.

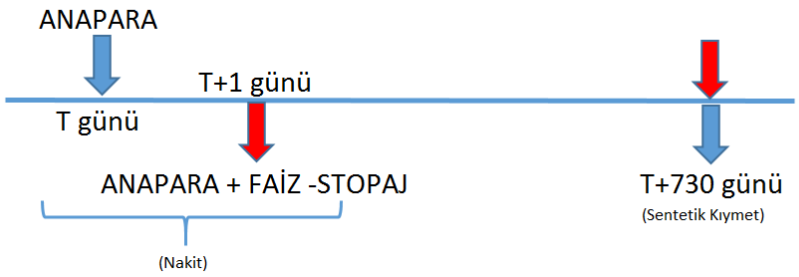


Figure 18 - Repo-Reverse Repo and Interbank Repo Market - Phase 1 Repo Party General Cash Flow

The repo member must make the security allocation until 15:00 on value date 1. After that time, the risk calculation moves to the 2nd phase. The risk calculation shall still be conducted based on the synthetic security further to the allocations made before 15:00, and the actual securities subject to the transaction shall be used for the risk calculations to be conducted after 15:00. When the repo member's 2nd phase cash flows schematized below are analyzed, it is seen that the net present values of the securities' cash flows are netting-off each other albeit the securities are known. That is, even though the cash flows change in the 2nd phase, this would have no effect mathematically.

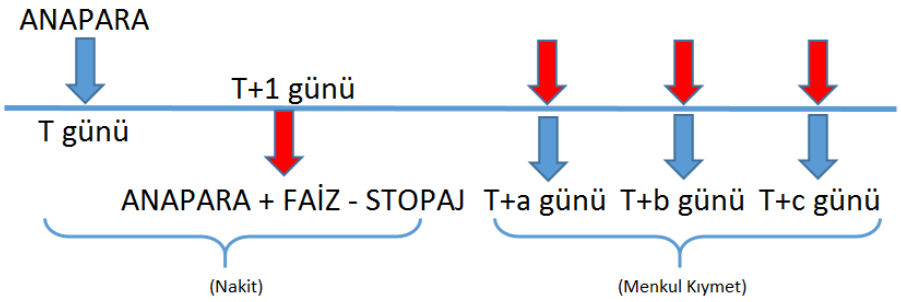


Figure 19 - Repo-Reverse Repo and Interbank Repo Market - Phase 2 Repo Party General Cash Flow

Upon completion of the settlement of the repo's first leg, the risk is calculated by the remaining cash flows and the risk for the repo member relatively increases compared to the first and second phases. When the repo member's 3rd phase cash flows schematized below are

analyzed, it is seen that the risk value increases because the number of days between the cash flows is greater than the first 2 phases. At the 3rd phase of repo, the security made subject to the repo is kept in a blocked account on behalf of the reverse-repo member and not delivered to the reverse-repo member. Hence, the reverse-repo member shall have no settlement obligation upon completion of the 2nd phase. When we draw the cash flows, it is seen that there is not any cash flow with respect to the security other than the cash to be received on value date 2. In that case, no risk value shall remain for the reverse-repo member at the 3rd phase.

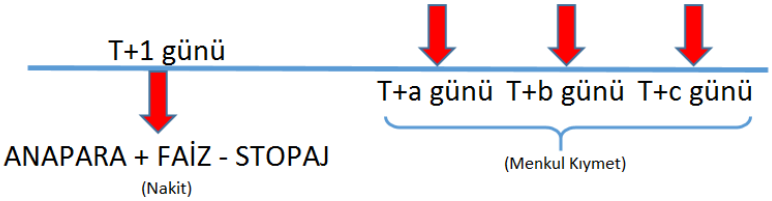


Figure 20 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Repo Party General Cash Flow

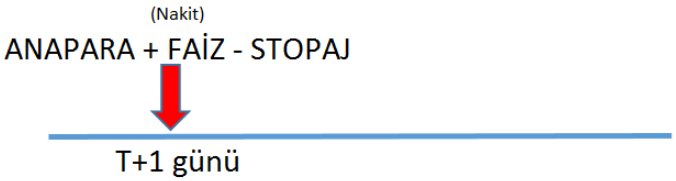


Figure 21 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Reverse Repo Party General Cash Flow

Upon completion of the 3rd phase of repo, no settlement obligation would remain neither for the repo member nor the reverse-repo member, and the risk shall be zeroized.

Illustrative Repo Transaction: Let's assume that a S-NORMAL_REPN_T0-ON repo transaction with a nominal value of 10 million TL is conducted between member A and member B at 13,25% interest rate. In that case, the interest amount of the repo transaction shall be $10.000.000 * 13{,}25\% * \frac{1}{365} = 3.630$ TL. 15% of this figure being 545 TL is the withholding amount. That is, the settlement obligation to be paid by the repo member on value date 2 shall be 10.003.086 TL.

Phase 1 - Repo Member: The schematized form of the 1st phase cash flow table of the member A engaging in a repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash inflow on T+0 and a cash outflow on T+1. In addition, 2-years synthetic security is also included in the cash flow table.

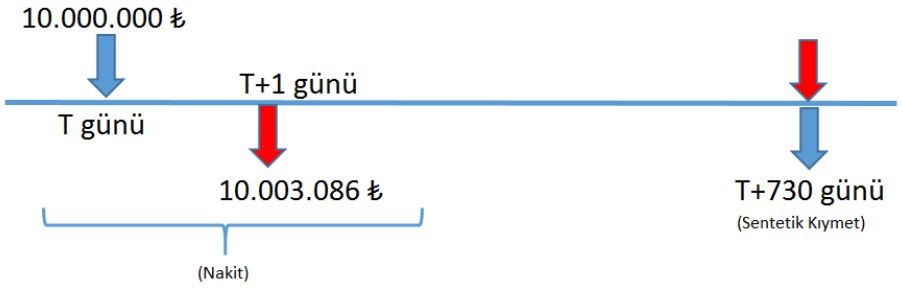


Figure 22 - Repo-Reverse Repo and Interbank Repo Market - Phase 1 Repo Party Cash Flow Example

Table 17 - Repo-Reverse Repo and Interbank Repo Market - Phase 1 Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	10.000.000 ₺	- 9.999.688 ₺	
Stressed NPV	10.000.000 ₺	- 10.002.222 ₺	
Initial Margin	- ₺	2.534 ₺	-2.534 ₺
Variation Margin	10.000.000 ₺	- 9.999.688 ₺	312 ₺
		Total Margin	- 2.222 ₺

Because the value date 2 amount of overnight repo transaction in the example is 10.003.086 TL, the net present value of this amount at 13.2% discount rate shall be 9.999.688 TL. And 312 TL difference between that amount and 10.000.000 TL to be received today makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of value date 1 remains constant at 10.000.000 TL and the net present value of value date 2 increases to 10.002.222 TL. After performing these transactions, the initial margin is found as 2.534 TL.

Because the net present value of value date 2 in this repo buying transaction is less than the amount of value date 1, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 2.222 TL.

Phase 1 - Reverse-Repo Member: The schematized form of the 1st phase cash flow table of the member B engaging in a reverse-repo transaction shall be as follows. Because it is a repo selling transaction, there is a cash outflow on T+0 and a cash inflow on T+1. In addition, 2-years synthetic security is also included in the cash flow table.

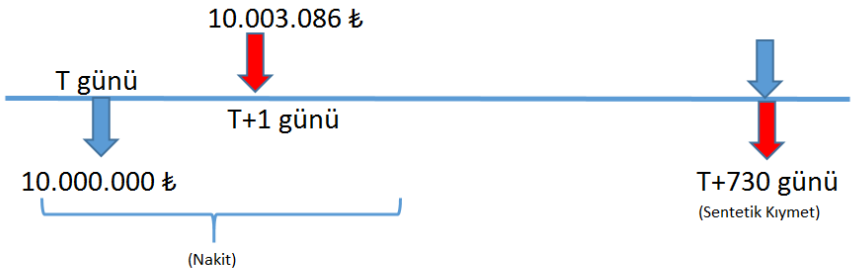


Figure 23 - Repo-Reverse Repo and Interbank Repo Market - Phase 1 Reverse Repo Party Cash Flow Example

Table 18 - Repo-Reverse Repo and Interbank Repo Market - Phase 1 Reverse Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	- 10.000.000 ₺	9.999.688 ₺	
Stressed NPV	- 10.000.000 ₺	9.997.369 ₺	
Initial Margin	- ₺	2.319 ₺	- 2.319 ₺
Variation Margin	- 10.000.000 ₺	9.999.688 ₺	- 312 ₺
		Total Margin	- 2.631 ₺

Because the value date 2 amount of the overnight repo transaction in the example is 10.003.086 TL, the net present value of this amount at 13.2% discount rate shall be 9.999.688 TL. And 312 TL difference between that amount and 10.000.000 TL to be paid today makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow

in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of value date 1 remains constant at 10.000.000 TL and the net present value of value date 2 decreases to 9.997.369 TL. After performing these transactions, the initial margin is found as 2.319 TL.

Because the net present value of value date 2 in this repo selling transaction is less than the amount of value date 1, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 2.631 TL.

Phase 2 - Repo Member: Member A must make the security allocation subject to the repo until 15:00 on value date 1.

Let's assume that the repo allocation prices of the securities eligible for repo, with a term of T+100, T+200 and T+300 and theoretical prices of 96.8 TL, 93.9 TL and 91.3 TL respectively are 96 TL, 93 TL and 90 TL again respectively. If these securities are entirely made somewhat subject to repo, allocations shall be made in units that would not be less than 10.003.630 TL in total. Further to the allocations made in units given in the below table, the security allocation process is completed.

Table 19 - Repo-Reverse Repo and Interbank Repo Market - Repo Security Allocation Example

	Theoretical Price	**Allocation Price**	**Unit**	**Allocation Price * Unit**
T+100	96,8 ₺	96,0 ₺	5.000.000	4.800.000 ₺
T+200	93,9 ₺	93,0 ₺	3.000.000	2.790.000 ₺
T+300	91,3 ₺	90,0 ₺	2.682.000	2.413.800 ₺
			Total	**10.003.800 ₺**

On the other hand, the schematized form of the 2nd phase cash flow table of the member A engaging in a repo transaction after 15:00 on value date 1 shall be as follows in the system. Because it is a repo buying transaction, there is a cash inflow on T+0 and a cash outflow on T+1. Given that both inflow and outflow records of the securities subject to the repo are included, they shall net-off each other and have no effect on the risk calculation.

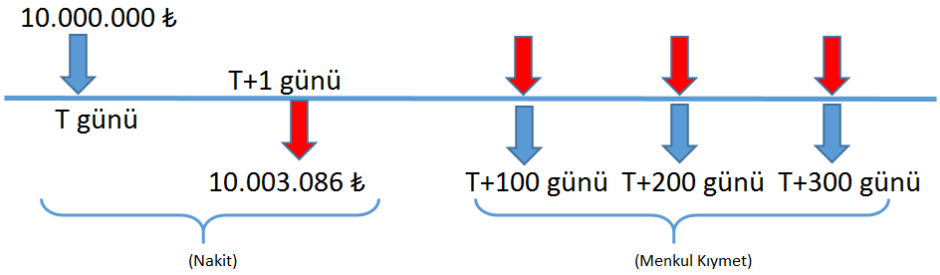


Figure 24 - Repo-Reverse Repo and Interbank Repo Market - Phase 2 Repo Party Cash Flow Example

Table 20 - Repo-Reverse Repo and Interbank Repo Market - Phase 2 Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	10.000.000 ₺	-9.999.688 ₺	
Stressed NPV	10.000.000 ₺	-10.002.222 ₺	
Initial Margin	- ₺	2.534 ₺	- 2.534 ₺
Variation Margin	10.000.000 ₺	-9.999.688 ₺	312 ₺
		Total Margin	- 2.222 ₺

Because the value date 2 amount of the overnight repo transaction in the example is 10.003.086 TL, the net present value of this amount at 13.2% discount rate shall be 9.999.688 TL. 312 TL difference between that amount and 10.000.000 TL to be received today makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of value date 1 remains constant at 10.000.000 TL and the net present value of value date 2 increases to 10.002.222 TL. After performing these transactions, the initial margin is found as 2.534 TL.

Because the net present value of value date 2 in this repo buying transaction is less than the amount of value date 1, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 2.222 TL.

As is seen, the 2nd phase of repo is not mathematically different from phase 1.

Phase 2 - Reverse Repo Member: Member A must make the security allocation subject to the repo until 15:00 on value date 1. Let's assume that three zero-coupon securities with a term to maturity of 100 days, 200 days and 300 days are made subject to repo by member A. On the other hand, the schematized form of the 2nd phase cash flow table of the member B engaging in a repo transaction after 15:00 on value date 1 shall be as follows in the system. Because it is a repo buying transaction, there is a cash outflow on T+0 and a cash inflow on T+1. Given that there are both entry and exit records of the securities subject to the repo, they shall net-off each other and have no effect on the risk calculation.

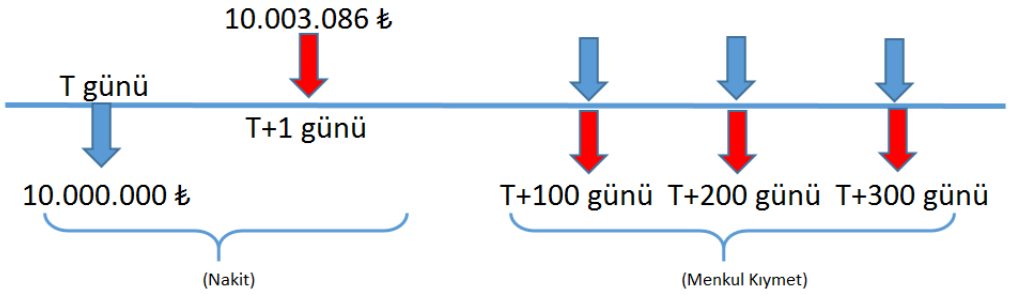


Figure 25 - Repo-Reverse Repo and Interbank Repo Market - Phase 2 Reverse-Repo Party Cash Flow Example

Table 21 - Repo-Reverse Repo and Interbank Repo Market - Phase 2 Reverse-Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	- 10.000.000 ₺	9.999.688 ₺	
Stressed NPV	- 10.000.000 ₺	9.997.369 ₺	
Initial Margin	- ₺	2.319 ₺	- 2.319 ₺
Variation Margin	- 10.000.000 ₺	9.999.688 ₺	- 312 ₺
		Total Margin	- 2.631 ₺

Because the value date 2 amount of the overnight repo transaction in the example is 10.003.086 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.688 TL. 312 TL difference between that amount and 10.000.000 TL to be paid today makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the

example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of value date 1 remains constant at 10.000.000 TL and the net present value of value date 2 decreases to 9.997.369 TL. After performing these transactions, the initial margin is found as 2.319 TL.

Because the net present value of value date 2 in this repo selling transaction is less than the amount of value date 1, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 2.631 TL.

As is seen, the phase 2 process of repo is also not mathematically different from the phase 1 with respect to the reverse-repo member.

Phase 3 - Repo Member: At the moment of risk calculation running upon fulfilment by the members A and B of their settlement obligations at the first leg of repo, the calculation shall now be made as if half of the cash flows disappear. In such process, the schematized form of the 3rd phase cash flow table of the member A shall be as follows in the system. Because it is a repo buying transaction, there is a cash outflow on T+1 and there are cash inflows on T+100, T+200 and T+300.

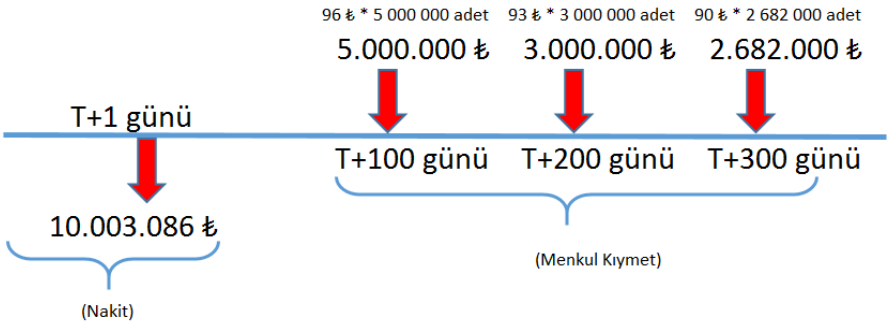


Figure 26 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Repo Party Cash Flow Example

Table 22 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Repo Party Risk Calculation Example

	Cash	Security	
Unstressed NPV	- 9.999.688 ₺	10.102.170 ₺	
Stressed NPV	- 9.997.369 ₺	9.695.676 ₺	
Initial Margin	-2.319 ₺	406.494 ₺	- 404.175 ₺
Variation Margin	- 9.999.688 ₺	10.102.170 ₺	102.482 ₺
		Total Margin	- 301.693 ₺

Because the cash amount of the overnight repo transaction in the example is 10.003.086 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.688 TL. The net present value of the securities made subject to the repo becomes 10.102.170 TL and 102.482 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly at the cash leg and then on the security leg are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash leg decreases to 9.997.369 TL and the net present value of the security leg decreases to 9.695.676 TL. After performing these transactions, the initial margin is found as 404.175 TL.

Because the net present value of the security leg in this repo buying transaction is more than the net present value of the cash leg, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 301.693 TL.

Phase 3 - Reverse-Repo Member: At the moment of risk calculation running upon fulfilment by the members A and B of their settlement obligations at the first leg of repo, the calculation shall now be made as if a part of the cash flows disappear. In this process, member B has already provided the cash under its obligation but the securities against repo could not be taken over since they are kept in the blocked account. The schematized form of the 3rd phase cash flow table of the member B shall be as follows in the system. As is seen from the cash flows, member B has a cash receivable on T+1 day but has no cash outflow.

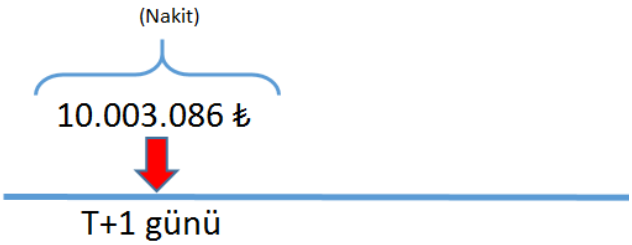


Figure 27 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Reverse-Repo Party Cash Flow Example

At the 3rd phase of this repo type, there is a parameter called “blockage credit haircut” which can be configured in the system. That haircut applies a haircut to the only cash flow available in the system and makes the risk calculation based on such amount. The said haircut is intended to be used as 0%. Now, let’s exemplify 10% and 0% applied versions of that haircut. When the blockage credit haircut is configured as 10%, the cash leg amount of 10.003.086 TL shall be multiplied by 10% and computed as 1.000.308 TL, and the net present value of that amount shall be calculated. The net present value of that amount at a discount rate of 13.2% amounts to 999.969 TL. When the risk scenario for a rise in interests is applied, the net present value of the cash decreases to 999.737 TL and the difference of 232 TL becomes the initial margin. Yet, the positive variation margin of 999.969 TL being calculated leads the member to have a credit status of 999.737 TL. In this case, no risk shall be calculated for the member, rather a credit is calculated on top of it. The member becomes entitled to take additional risk of 999.747 TL.

Table 23 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Reverse Repo Party Risk Calculation Example (10% haircut)

	Cash	Security	
Unstressed NPV	999.969 ₺	- ₺	
Stressed NPV	999.737 ₺	- ₺	
Initial Margin	-232 ₺	- ₺	- 232 ₺
Variation Margin	999.969 ₺	- ₺	999.969 ₺
		Total Margin	999.737 ₺

When the blockage credit haircut is configured as 0%, the cash leg amounting to 10.003.086 TL shall be multiplied by 0 and all risk components become 0. In this case, there shall be no margin requirement for the reverse-repo member at the 3rd phase of this repo type. .

Table 24 - Repo-Reverse Repo and Interbank Repo Market - Phase 3 Reverse Repo Party Risk Calculation Example (0% haircut)

	Cash	Security	
Unstressed NPV	- ₺	- ₺	
Stressed NPV	- ₺	- ₺	
Initial Margin	- ₺	- ₺	- ₺
Variation Margin	- ₺	- ₺	- ₺
		Total Margin	- ₺

6.3. Repo Market for Specified Securities

In this market operating to facilitate execution of the repo/reverse-repo transactions on the specified securities and then delivery of these securities to the buyer in accordance with the organized market conditions, the private sector debt instruments can also be used as trade consideration in addition to the government domestic debt securities. Before the transaction is executed, that is, at the order stage, the buyer and seller parties know at which price they will trade which security as consideration for trade.

Before the transaction, the ISIN code of the security subject to the transaction is known. The securities allocated as trade consideration are not blocked, and made available to the use of the party engaging in reverse-repo. A transaction conducted in the Repo Market for Specified Securities can also be considered as two concurrent and connected outright purchase/sale transactions. Security in an amount sufficient to cover the principal amount of the transaction must be delivered. Since the security identification and the required amount are already known at the order stage, no security allocation shall further be made after the transaction.

Table 25 - Functioning of RMFSS

	Ters Repocu	Repocu
V1	- İşlem tutarını öder - Repocunun verdiği menkul kıymetler serbest deposuna geçer	- Menkul kıymetleri teslim eder - Ters repocunun ödediği tutar hesabına geçer
V2	- Menkul kıymetleri iade eder - Anapara+faiz-stopaj tutarı hesabına geçilir.	- Anapara+faiz tutarını öder - Menkul kıymetler serbest deposuna geçer - Stopaj tutarını ters repocu adına vergi dairesine yatırır

In the risk calculation according to the Cash Flow Margining Method, the process in this repo market is divided into two phases, and the risk calculation differs at these phases.

- 1st phase: between the trade time and the completion of settlement of the repo's first leg.
- 2nd phase: between the completion of settlement of the repo's first leg and the completion of settlement of the repo's second leg.

When the cash flows of the repo and reverse-repo members at the 1st phase of the repo transaction are analyzed, it is seen that the net present values of the securities' cash flows are netting-off each other albeit the securities are known. The repo and reverse-repo members' cash flows at the 1st phase are respectively schematized below. The blue arrows in the figure represent the first leg of repo and the red arrows represent the second leg of repo.

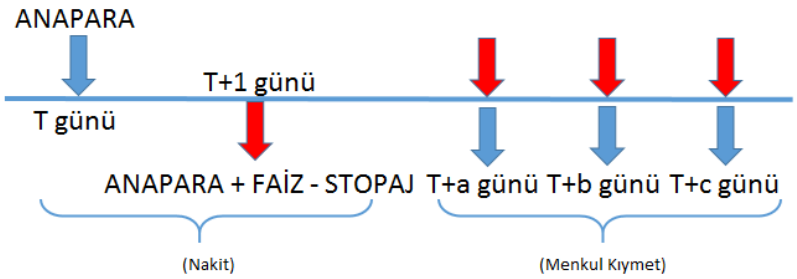


Figure 28 - RMFSS Phase 1 Repo Party General Cash Flow

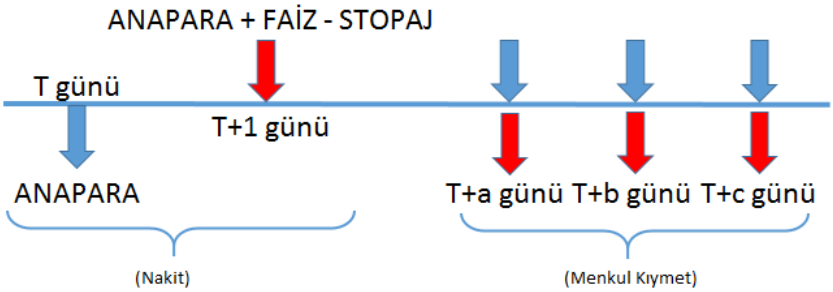


Figure 29 - RMFSS Phase 1 Reverse-Repo Party General Cash Flow

The cash flows remaining upon completion of the settlement of the repo's first leg are just the cash flows that belong to the repo's second leg, and the risk shall be calculated based on such remaining cash flows. The repo and reverse-repo members' cash flows at the 2nd phase are respectively schematized below. Given that no record has left in the cash flows for the repo's first leg, the cash flows are indicated by red arrows representing just the second leg.

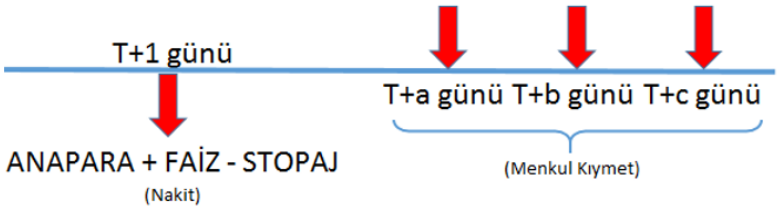


Figure 30 - RMFSS Phase 2 Repo Party General Cash Flow

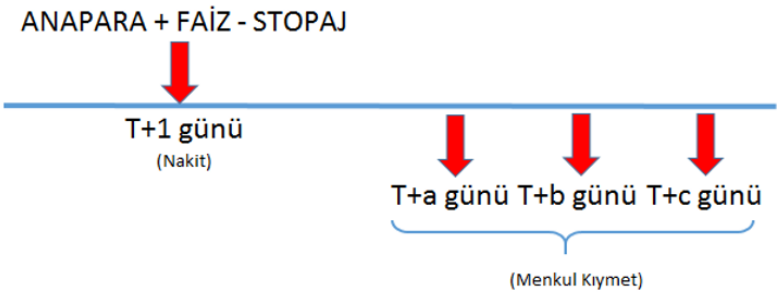


Figure 31 - RMFSS Phase 2 Reverse-Repo Party General Cash Flow

Illustrative Repo Transaction: Let's assume that a TRT241018T18_MKTR_T1-ON repo transaction with a nominal value of 10 million TL is conducted between member A and member B at 13,2% interest rate, by 91,5 TL repo security price on 22/01/18. In that case, the interest amount of the repo transaction shall be $10.000.000 * \%13{,}20 * \frac{1}{365} = 3.616$ ₺ olur. 15% of this figure being 542 TL is the withholding amount. That is, the settlement obligation to be paid by the repo member on value date 2 shall be 10.003.074 TL.

Phase 1 - Repo Party Member: The schematized form of the 1st phase cash flow table of the member A engaging in a repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash inflow on T+1 and a cash outflow on T+2. Given that both the inflow and outflow records of the discounted TRT241018T18 security with a term to maturity of 275 days are included in the cash flow table, it has no effect on the risk result in total.

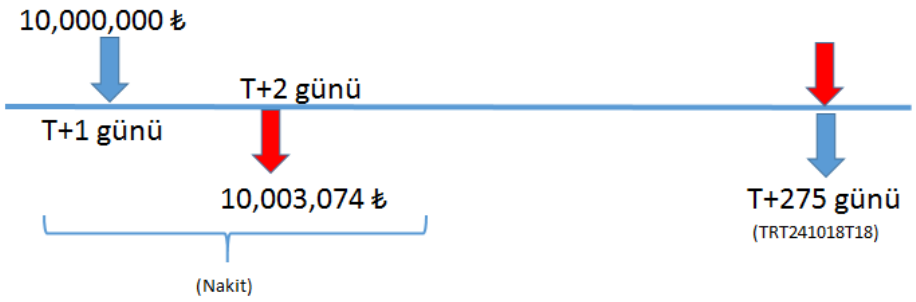


Figure 32 - RMFSS - Phase 1 Repo Party Cash Flow Example

Table 26 - RMFSS - Phase 1 Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	9,996,604 ₺	- 9,996,305 ₺	
Stressed NPV	9,999,137 ₺	- 10,001,374 ₺	
Initial Margin	-2,533 ₺	5,070 ₺	- 2,536 ₺
Variation Margin	9,996,604 ₺	-9,996,305 ₺	299 ₺
		Total Margin	- 2,237 ₺

Because the value date 2 amount of the overnight repo transaction in the example is 10.003.074 TL, the net present value of this amount at 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL, representing the value date 1 amount at 13.2% discount rate, becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of value date 1 increases to 9.999.137 TL and the net present value of value date 2 increases to 10.001.374 TL. After performing these transactions, the initial margin is found as 2.536 TL.

Because the net present value of the value date 2 in this repo buying transaction is less than the net present value of the value date 1, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 2.237 TL.

Phase 1 - Reverse-Repo Member: The schematized form of the 1st phase cash flow table of the member B engaging in a reverse-repo transaction shall be as follows. Because it is a repo selling transaction, there is a cash outflow on T+1 and a cash inflow on T+2. Given that both the inflow and outflow records of the discounted TRT241018T18 security with a term to maturity of 275 days are included in the cash flow table, it has no effect on the risk result in total.

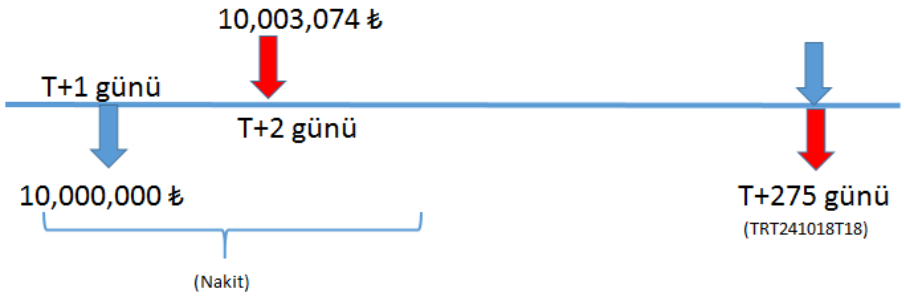


Figure 33 - RMFSS - Phase 1 Reverse-Repo Party Cash Flow Example

Table 27 - RMFSS - Phase 1 Reverse-Repo Party Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	-9,996,604 ₺	9,996,305 ₺	
Stressed NPV	-9,994,286 ₺	9,991,667 ₺	
Initial Margin	-2,318 ₺	4,638 ₺	- 2,319 ₺
Variation Margin	-9,996,604 ₺	9,996,305 ₺	- 299 ₺
		Total Margin	- 2,619 ₺

Because the value date 2 amount of the overnight repo transaction in the example is 10.003.074 TL, the net present value of this amount by 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL being the value date 1 amount by 13.2% discount rate becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated

and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of value date 1 decreases to 9.994.286 TL and the net present value of value date 2 decreases to 9.991.667 TL. After performing these transactions, the initial margin is found as 2.319 TL.

Because the net present value of the value date 2 in this repo selling transaction is less than the net present value of the value date 1, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 2.619 TL.

Phase 2 - Repo Member: Given the repo security price of the discounted TRT241018T18 security with a term to maturity of 275 days is 91,5 TL, member A must present $\frac{10.000.000}{91,5} = 109.290$ units of TRT241018T18 security for settlement against the repo. Upon presentation of 10.000.000 TL cash by member B, settlement of the repo's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member A engaging in a repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash outflow on T+1 and a cash inflow of 10.929.000 TL on T+274. In this form, the repo resembles to an outright purchase/sale transaction.

Figure 34 - RMFSS - Phase 2 Repo Party Cash Flow Example

Table 28 - RMFSS - Phase 2 Repo Party Risk Calculation Example

	Cash	Security	
Unstressed NPV	-9,999,677 ₺	9,999,498 ₺	
Stressed NPV	-9,997,358 ₺	9,380,624 ₺	
Initial Margin	-2,319 ₺	618,874 ₺	-616,555 ₺
Variation Margin	-9,999,677 ₺	9,999,498 ₺	-178 ₺

Total Margin	-616,733 ₺

Because the cash amount of the overnight repo transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. The net present value of the security by 12.57% discount rate becomes 9.999.498 TL. And 178 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly at cash and then at the security are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 9.997.358 TL and the net present value of the security decreases to 9.380.624 TL. After performing these transactions, the initial margin is found as 616.555 TL.

Because the net present value of the security in this repo buying transaction is more than the net present value of the cash, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 616.733 TL.

Phase 2 - Reverse-Repo Member: Given the repo security price of the discounted TRT241018T18 security with a term to maturity of 275 days is 91,5 TL, member A must present $\frac{10.000.000}{91,5} = 109.290$ units of TRT241018T18 security for settlement against the repo. Upon presentation of 10.000.000 TL cash by member B, settlement of the repo's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member B engaging in a reverse-repo transaction shall be as follows. Because it is a repo selling transaction, there is a cash inflow on T+1 and a cash outflow of 10.929.000 TL on T+274. In this form, the repo resembles to an outright purchase/sale transaction.

Figure 35 - RMFSS - Phase 2 Reverse-Repo Party Cash Flow Example

Table 29 - RMFSS - Phase 2 Reverse-Repo Party Risk Calculation Example

	Cash	Security	
Unstressed NPV	9,999,677 ₺	-9,999,498 ₺	
Stressed NPV	10,002,211 ₺	-10,722,785 ₺	
Initial Margin	-2,534 ₺	723,287 ₺	-720,753 ₺
Variation Margin	9,999,677 ₺	-9,999,498 ₺	178 ₺
		Total Margin	-720,575 ₺

Because the cash amount of the overnight repo transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. The net present value of the security by 12.57% discount rate becomes 9.999.498 TL. And 178 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly at cash and then at the security are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the cash increases to 10.002.211 TL and the net present value of the security increases to 10.722.785 TL. After performing these transactions, the initial margin is found as 720.753 TL.

Because the net present value of the security in this repo selling transaction is less than the net present value of the cash, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 720.575 TL.

6.4. Equity Repo Market

The shares traded in the Equity Repo Market operating to facilitate engagement of repo on the shares and delivery of these shares to the buyer are those that are traded in the Equity Market BIST30 index. On the start date, the shares subject to the transaction are delivered by the repo party to the reverse-repo party with a promise to buy them back on the expiry date. In terms of its functioning, it may be likened to the Repo Market for Specified Securities. In both of these markets, the identification of the security subject to the transaction is known at the order stage, before the transaction.

In the risk calculation of the Equity Repo instruments traded in the Debt Securities Market, the Cash Flow Margining Method applied in the risk calculation of the fixed income securities and the Delta Hedge Margin Method applied in the risk calculation of the equities are jointly used. After the identification of the cash flow according to this model called as hybrid risk method, the equity portion of the position is made subject to the risk calculation by the Delta Hedge Margin Method, whereas its cash portion is made subject to the risk calculation by the Cash Flow Margining Method.

In the risk calculation at the Equity Repo Market, the process is divided into two phases and the risk calculation differs at these phases.

- 1st phase: between the trade time and the completion of settlement of the repo's first leg.
- 2nd phase: between the completion of settlement of the repo's first leg and the completion of settlement of the repo's second leg.

The 1st phase cash flows of the repo and reverse-repo members engaging in overnight equity repo transactions are respectively schematized below. The blue arrows in the figure represent the cash portion of repo and the red arrows represent the equity leg of repo.

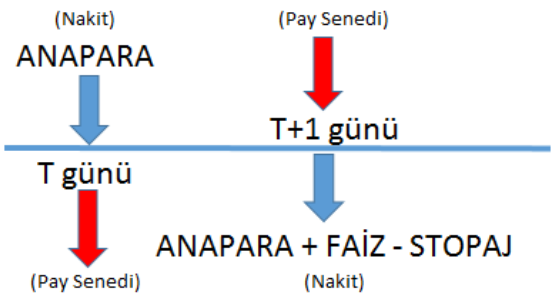


Figure 36 - Equity Repo - Phase 1 Repo Party General Cash Flow

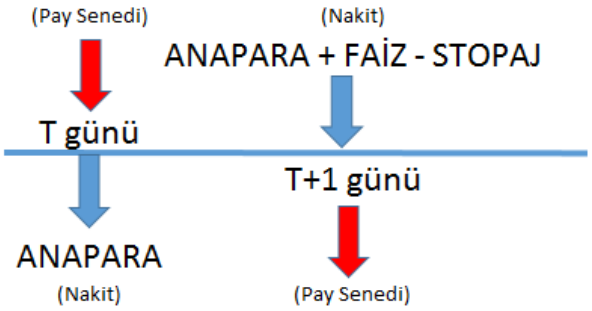


Figure 37 - Equity Repo - Phase 1 Reverse-Repo Party General Cash Flow

The cash flows remaining upon completion of the settlement of the repo's first leg are just the cash flows that belong to the repo's second leg, and the risk shall be calculated based on such remaining cash flows. The 2nd phase cash flows of the repo and reverse-repo members engaging in overnight equity repo transactions are respectively schematized below.

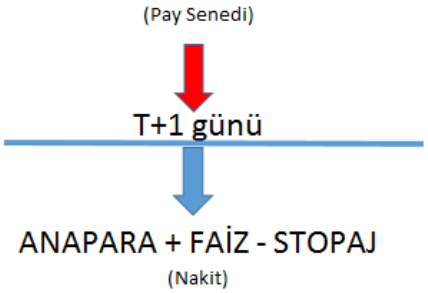


Figure 38 - Equity Repo - Phase 2 Repo Party General Cash Flow

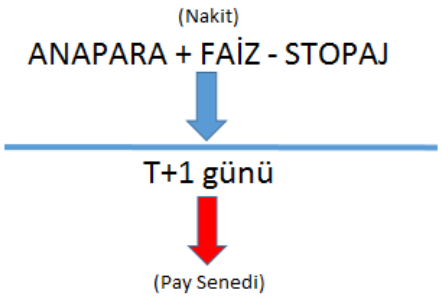


Figure 39 - Equity Repo - Phase 2 Reverse-Repo Party General Cash Flow

Illustrative Repo Transaction: Let's assume that a AKBNK.E_PREP_T1-ON repo transaction with a nominal value of 10 million TL is conducted between member A and member B at 13,2% interest rate, by 10 TL repo equity price. As per this transaction, the settlement obligation of the repo party on value date 1 shall be $\frac{10.000.000}{10} = 1.000.000$ units of AKBNK.CE share. In that case, the interest amount of the repo transaction shall be $10.000.000 * 13{,}20\% * \frac{1}{365} = 3.616$ TL. 15% of this figure being 542 TL is the withholding amount. That is, the settlement obligation to be paid by the repo member on value date 2 shall be 10.003.074 TL

Phase 1 - Repo Member: The schematized form of the 1st phase cash flow table of the member A engaging in a repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash inflow on T+1 and a cash outflow on T+2. Likewise, there is an outflow of 1.000.000 units of AKBNK.CE shares on T+1, whereas there is an inflow of AKBNK.CE shares at the same amount on T+2.

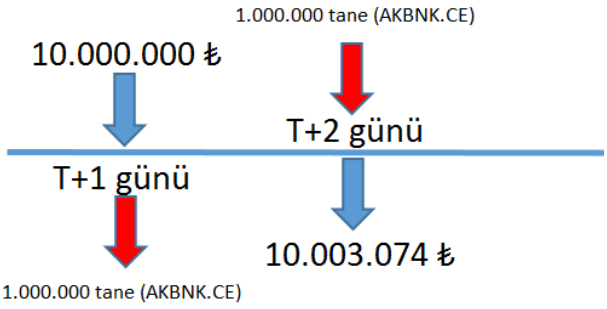


Figure 40 - Equity Repo - Phase 1 Repo Party Cash Flow Example

Table 30 - Equity Repo - Phase 1 Repo Party Risk Calculation Example

CASH	Value Date 1	Value Date 2	
Unstressed NPV	9.996.604 ₺	-9.996.305 ₺	
Stressed NPV	9.999.137 ₺	-10.001.374 ₺	
Initial Margin	-2.533 ₺	5.070 ₺	-2.536 ₺
Variation Margin	9.996.604 ₺	-9.996.305 ₺	299 ₺
AKBNK.CE	Value Date 1	Value Date 2	
Initial Margin	-900.000 ₺	1.090.000 ₺	- 190.000 ₺
Variation Margin	-9.950.000 ₺	9.950.000 ₺	- ₺
		CFM + DELTA HEDGE	
		Initial Margin	- 192.536 ₺
		Variation Margin	299 ₺
		Total Margin	- 192.237 ₺

Because the value date 2 amount for the cash leg of the overnight repo transaction in the example is 10.003.074 TL, the net present value of this amount by 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL, representing the value date 1 amount at 13.2% discount rate, becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the value date 1 increases to 9.999.137 TL and the net present value of the value date 2 increases to 10.001.374 TL. After performing these transactions, the initial margin is found as 2.536 TL.

In calculating the initial margin arising from the equity, the risk parameters used for the equity and the margin price of the share play an important role. Let’s assume that 0 and 1-day PSRs are 9,2%, 2-days PSR is 11% and the margin price of AKBNK.CE is 9,95 TL. In that case, the initial margin of value date 1 and of value date 2 shall be 900.000 TL and 1.090.000 TL respectively. 190.000 TL difference between them accounts to the initial margin arising from the equity. Given that there are records netting-off each other on the side of variation margin arising from the equity, it shall have no effect on the risk calculation.

Because the net present value of value date 2 in this repo buying transaction is less than the net present value of value date 1, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 192.237 TL.

Phase 1 - Reverse-Repo Member: The schematized form of the 1st phase cash flow table of the member B engaging in a reverse-repo transaction shall be as follows. Because it is a repo selling transaction, there is a cash outflow on T+1 and a cash inflow on T+2. Likewise, there is an inflow of 1.000.000 units of AKBNK.CE shares on T+1, whereas there is an outflow of AKBNK.CE shares at the same amount on T+2.

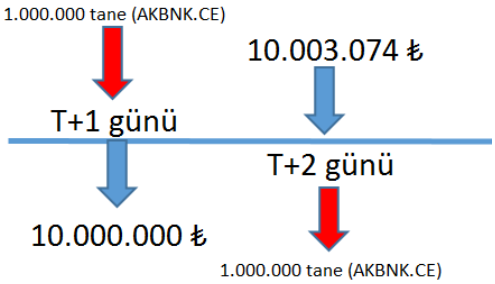


Figure 41 - Equity Repo - Phase 1 Reverse-Repo Cash Flow Example

Table 31 - Equity Repo - Phase 1 Reverse-Repo Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	-9.996.604 ₺	9.996.305 ₺	
Stressed NPV	-9.994.286 ₺	9.991.667 ₺	
Initial Margin	-2.318 ₺	4.638 ₺	-2.319 ₺
Variation Margin	-9.996.604 ₺	9.996.305 ₺	-299 ₺
AKBNK.CE	Value Date 1	Value Date 2	
Initial Margin	900.000 ₺	-1.090.000 ₺	-190.000 ₺
Variation Margin	9.950.000 ₺	-9.950.000 ₺	- ₺
		CFM + DELTA HEDGE	
		Initial Margin	-192.319 ₺
		Variation Margin	-299 ₺
		Total Margin	-192.619 ₺

Because the value date 2 amount for the cash leg of the overnight repo transaction in the example is 10.003.074 TL, the net present value of this amount by 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL, representing the value date 1 amount at

13.2% discount rate, becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on value date 1 and then on value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the value date 1 decreases to 9.994.286 TL and the net present value of the value date 2 decreases to 9.991.667 TL. After performing these transactions, the initial margin is found as 2.319 TL.

In calculating the initial margin arising from the equity, the risk parameters used for the equity and the margin price of the share play an important role. Let's assume that 0 and 1-day PSRs are 9,2%, 2-days PSR is 11% and the margin price of AKBNK.CE is 9,95 TL. In that case, the initial margin of value date 1 and of value date 2 shall be 900.000 TL and 1.090.000 TL respectively. 190.000 TL difference between them accounts to the initial margin arising from the equity. Given that there are records netting-off each other on the side of variation margin arising from the equity, it shall have no effect on the risk calculation.

Because the net present value of value date 2 in this repo selling transaction is less than the net present value of value date 1, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 192.619 TL.

Phase 2 - Repo Member: Member A must present 1.000.000 units of AKBNK.CE shares arising from the equity repo transaction for settlement against the repo on value date 1. Upon presentation of 10.000.000 TL cash by member B, settlement of the repo's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member A engaging in a repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash outflow on T+1 and an inflow of 1.000.000 units of AKBNK.CE shares.

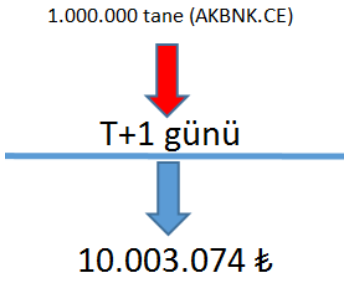


Figure 42 - Equity Repo - Phase 2 Repo Party Cash Flow Example

Table 32 - Equity Repo - Phase 2 Repo Party Risk Calculation Example

CASH	Value Date 2
Unstressed NPV	-9.999.677 ₺
Stressed NPV	-10.002.211 ₺
Initial Margin	2.534 ₺
Variation Margin	-9.999.677 ₺
AKBNK.CE	Value Date 2
Initial Margin	900.000 ₺
Variation Margin	10.050.000 ₺
CFM + DELTA HEDGE	
Initial Margin	-902.534 ₺
Variation Margin	50.323 ₺
Total Margin	-852.211 ₺

Because the cash amount of the overnight repo transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. Assuming that the price of AKBANK.CE on the value date 1 increases to 10,05 TL, the net present value of the security becomes 10.050.000 TL. And 50.323 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows are calculated at first and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a fall in interest rates. When the risk scenario is applied, in other words, if the interest rates decrease, the net present value of the cash increases to 10.002.211 TL. In calculating the initial margin of the security, one day PSR value of 9% parameter is used and the initial margin is

computed as 900.000 TL. After performing these transactions, the initial margin is found as 902.534 TL.

Because the net present value of the security in this repo buying transaction is more than the net present value of the cash, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 852.211 TL.

Phase 2 - Reverse Repo Member: Member A must present 1.000.000 units of AKBNK.CE shares arising from the equity repo transaction for settlement against the repo on value date 1. Upon presentation of 10.000.000 TL cash by member B, settlement of the repo's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member B engaging in a reverse-repo transaction shall be as follows. Because it is a repo buying transaction, there is a cash outflow on T+1 and an inflow of 1.000.000 units of AKBNK.CE shares.

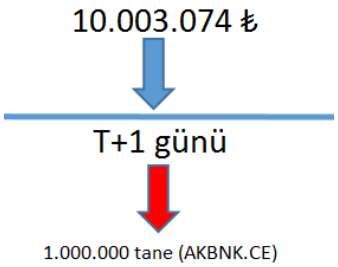


Figure 43 - Equity Repo - Phase 2 Reverse Repo Party Cash Flow Example

Table 33 - Equity Repo - Phase 2 Reverse Repo Party Risk Calculation Example

CASH	Value Date 2
Unstressed NPV	9.999.677 ₺
Stressed NPV	9.997.358 ₺
Initial Margin	2.319 ₺
Variation Margin	9.999.677 ₺
AKBNK.CE	Value Date 2
Initial Margin	900.000 ₺
Variation Margin	-10.050.000 ₺
CFM + DELTA HEDGE	
Initial Margin	-902.319 ₺
Variation Margin	-50.323 ₺
Total Margin	-952.642 ₺

Because the cash amount of the overnight repo transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. Assuming that the price of AKBANK.CE on the value date 1 increases to 10,05 TL, the net present value of the security becomes 10.050.000 TL. And 50.323 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows are calculated at first and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a rise in interest rates. When the risk scenario is applied, in other words, if the interest rates increase, the net present value of the cash decreases to 9.997.358 TL. In calculating the initial margin of the security, one day PSR value of 9% parameter is used and the initial margin is computed as 900.000 TL. After performing these transactions, the initial margin is found as 902.319 TL.

Because the net present value of the security in this repo selling transaction is more than the net present value of the cash, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 952.642 TL.

6.5. Committed Transactions Market

The model related to the multilateral committed purchase and sales contracts to which lease certificates or other capital market instruments accepted by the Exchange Board of Directors are subject in the Committed Transactions Market that will start to operate in Borsa Istanbul Debt Securities Market after BISTECH transition shall run as follows:

1. The brokerage house intending to conduct a multilateral committed purchase and sales transaction with the Lease Certificates and the capital market instruments found eligible by the Exchange Board of Directors to trade in this market shall enter its order in a manner to include information about the rate, the Securities Price and the trade (principal) amount.

2. Three transactions are materialized in a consecutive manner to the extend the code and settlement (Settlement 1) date criteria of the lease certificates subject to the transaction of the

entered orders are matched with the settlement (Settlement 2) date, rate, security price (Settlement 1 Price) criteria of the committed transaction.

3. The first transaction is a trade that is conducted between the brokerage house selling with a promise to buy back and the brokerage house purchasing with a promise to sell back.

4. The second transaction is a trade in which the brokerage house that has made a purchase with a promise to sell back in the first transaction would sell the security to Takasbank on the commitment (Settlement 2) date over the price it has committed and receive the proceeds of the transaction from Takasbank. In the second transaction, Takasbank (XTK) is a party to the contract as buyer.

5. The third transaction is a trade in which the brokerage house that has made a sale with a promise to buy back in the first transaction would buy the security from Takasbank on the commitment (Settlement 2) date over the price it has committed and pay the proceeds of the transaction to Takasbank. In the third transaction, Takasbank is a party to the contract as seller.

6. In the second and third transactions, Takasbank has the right to withdraw. If Takasbank exercises its right to withdraw, no legal liability shall arise thereof.

The schematic illustration of the first, second and third transactions mentioned above is given below:

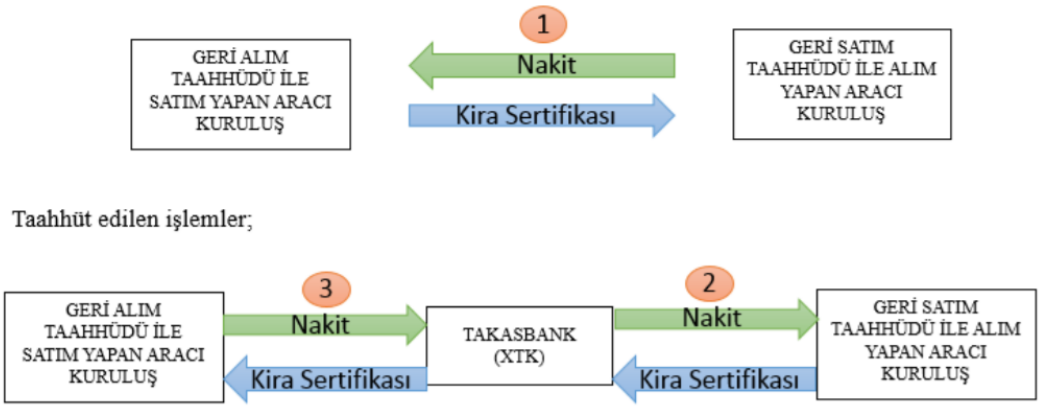


Figure 44 - Functioning of Committed Transactions Market

In the risk calculation according to the Cash Flow Margining Model, the process in this market is divided into two phases and the risk calculation differs at these phases.

- 1st phase: the process from the trade time to the fulfillment by the members of their obligations on settlement 1 day.
- 2nd phase: the process from the fulfillment by the members of their obligations on settlement 1 day to the fulfillment of their obligations on settlement 2 day.

When the buyer and seller members' cash flows at the 1st phase of the transaction are analyzed, it is seen that the net present values of the securities' cash flows are netting-off each other albeit the securities are known. The buyer and seller members' cash flows at the 1st phase are respectively schematized below. The blue arrows in the figure represent the first leg of the transaction and the red arrows represent the second leg of the transaction.

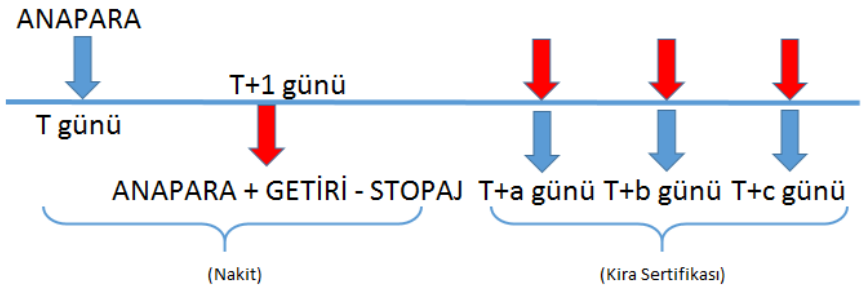


Figure 45 - Committed Transactions Market - Phase 1 Buyer General Cash Flow

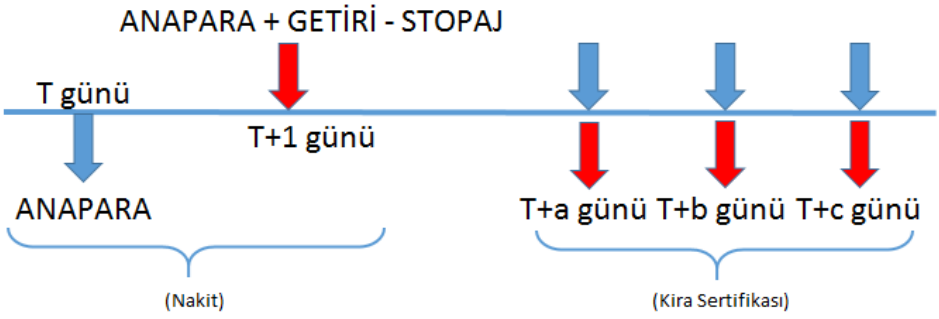


Figure 46 - Committed Transactions Market - Phase 1 Seller General Cash Flow

The cash flows remaining upon completion of the settlement of the transaction's first leg are just the cash flows that belong to the transaction's second leg, and the risk shall be calculated based on such remaining cash flows. The buyer and seller members' cash flows at the 2nd phase are respectively schematized below. Given that no record has left in the cash flows for the transaction's first leg, the cash flows are indicated by red arrows representing just the second leg.

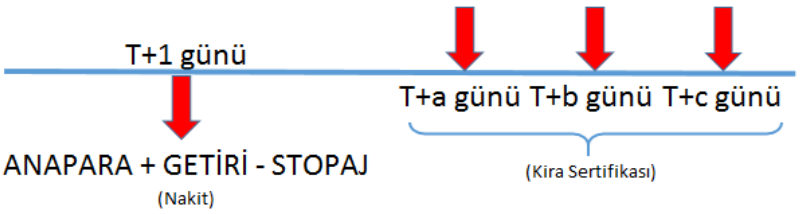


Figure 47 - Committed Transactions Market - Phase 2 Buyer General Cash Flow

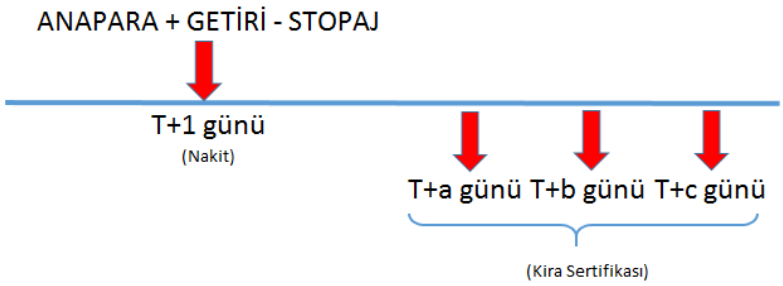


Figure 48 - Committed Transactions Market - Phase 2 Seller General Cash Flow

Illustrative Transaction: Let's assume that a TRD260918T17_STIP_T1-ON transaction with a nominal value of 10 million TL is conducted between member A and member B at 13,2% interest rate, by 100 TL security price on 22/01/18. In that case, the interest amount of the transaction shall be $10.000.000 * \%13{,}20 * \frac{1}{365} = 3.616$ TL. 15% of this figure being 542 TL is the withholding amount. That is, the settlement obligation to be paid by the buyer member on value date 2 shall be 10.003.074 TL.

Phase 1 - Buyer Member: The schematized form of the 1st phase cash flow table of the member A as the buyer shall be as follows. Because it is a buying transaction, there is a cash inflow on T+1 and a cash outflow on T+2. Given that both the inflow and outflow records of the discounted TRD260918T17 security with a term to maturity of 247 days are included in the cash flow table, it has no effect on the risk result in total.

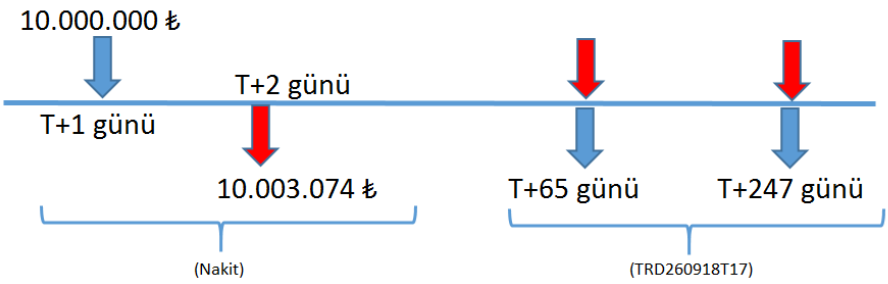


Figure 49 - Committed Transactions Market - Phase 1 Buyer Cash Flow Example

Table 34 - Committed Transactions Market - Phase 1 Buyer Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	9,996,604 ₺	-9,996,305 ₺	
Stressed NPV	9,999,137 ₺	-10,001,374 ₺	
Initial Margin	-2,533 ₺	5,070 ₺	- 2,536 ₺
Variation Margin	9,996,604 ₺	-9,996,305 ₺	299 ₺
		Total Margin	- 2,237 ₺

Because the value date 2 amount of the transaction in the example is 10.003.074 TL, the net present value of this amount by 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL being the value date 1 amount by 13.2% discount rate becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on the value date 1 and then on the value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a decline in proceeds. When the risk scenario is applied, in other words, if the proceeds fall, the net present value on the value date 1 increases to 9.999.137 TL and the net present value on the value date 2 increases to 10.001.374 TL. After performing these transactions, the initial margin is found as 2.536 TL.

Because the net present value of value date 2 in this buying transaction is less than the net present value of value date 1, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 2.237 TL.

Phase 1 - Seller Member: The schematized form of the 1st phase cash flow table of the member B as the seller shall be as follows. Because it is a selling transaction, there is a cash outflow on T+1 and a cash inflow on T+2. Given that both the inflow and outflow records of the discounted TRD260918T17 security with a term to maturity of 247 days are included in the cash flow table, it has no effect on the risk result in total.

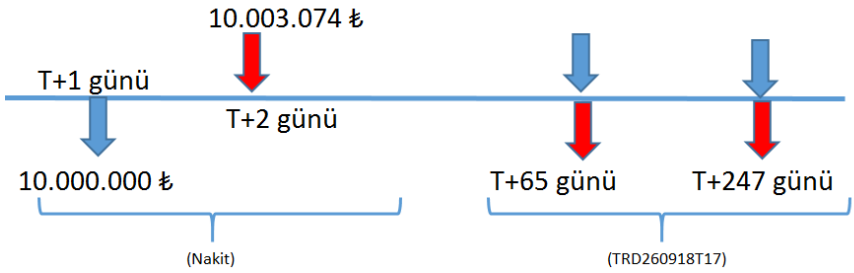


Figure 50 - Committed Transactions Market - Phase 1 Seller Cash Flow Example

Table 35 - Committed Transactions Market - Phase 1 Seller Risk Calculation Example

	Value Date 1	Value Date 2	
Unstressed NPV	- 9,996,604 ₺	9,996,305 ₺	
Stressed NPV	- 9,994,286 ₺	9,991,667 ₺	
Initial Margin	- 2,318 ₺	4,638 ₺	- 2,319 ₺
Variation Margin	- 9,996,604 ₺	9,996,305 ₺	- 299 ₺
		Total Margin	- 2,619 ₺

Because the value date 2 amount of the transaction in the example is 10.003.074 TL, the net present value of this amount by 13.15% discount rate shall be 9.996.305 TL. The net present value of 10.000.000 TL being the value date 1 amount by 13.2% discount rate becomes 9.996.604 TL. And 299 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash flows firstly on the value date 1 and then on the value date 2 are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is an increase in proceeds. When the risk scenario is applied, in other words, if the proceeds rise, the net present value on the value

date 1 decreases to 9.994.286 TL and the net present value on the value date 2 decreases to 9.991.667 TL. After performing these transactions, the initial margin is found as 2.319 TL.

Because the net present value of value date 2 in this selling transaction is less than the net present value of value date 1, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 2.619 TL.

Phase 2 - Buyer Member: Given the trade security price of the discounted TRD260918T17 security with a term to maturity of 246 days is 100 TL, member A must present $\frac{10.000.000}{100} = 100.000$ units of TRD260918T17 security for settlement against the transaction. Upon presentation of 10.000.000 TL cash by member B, settlement of the trade's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member A as the buyer shall be as follows. Because it is a buying transaction, there is a cash outflow on T+1 and a cash inflow on T+64 and on T+246. In this form, the transaction resembles to an outright purchase/sale transaction.

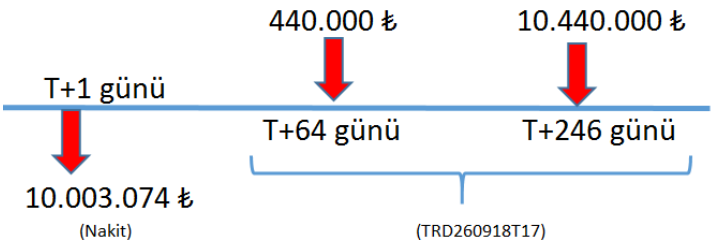


Figure 51 - Committed Transactions Market - Phase 2 Buyer Cash Flow Example

Table 36 - Committed Transactions Market - Phase 2 Buyer Risk Calculation Example

	Cash	Security	
Unstressed NPV	-9.999.677 ₺	10.068.252 ₺	
Stressed NPV	-9.997.358 ₺	9.524.773 ₺	
Initial Margin	-2.319 ₺	543.480 ₺	-541.161 ₺
Variation Margin	- 9.999.677 ₺	10.068.252 ₺	68.576 ₺
		Total Margin	-472.585 ₺

Because the cash amount of the transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. The net

present value of the security becomes 10.068.252 TL. And 68.576 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash inflow in the future, the risk scenario is an increase in proceeds. When the risk scenario is applied, in other words, if the proceeds rise, the net present value of the cash decreases to 9.997.358 TL and the net present value of the security decreases to 9.524.773 TL. After performing these transactions, the initial margin is found as 541.161 TL.

Because the net present value of the security in this buying transaction is more than the net present value of the cash, the variation margin reduces the total margin requirement. In that case, total margin requirement amounts to 472.585 TL.

Phase 2 - Seller Member: Given the trade security price of the discounted TRD260918T17 security with a term to maturity of 246 days is 100 TL, member A must present $\frac{10.000.000}{100} = 100.000$ units of TRD260918T17 security for settlement against the transaction. Upon presentation of 10.000.000 TL cash by member B, settlement of the trade's first leg shall be completed and the 2nd phase of the risk management process would start. The schematized form of the 2nd phase cash flow table of the member B as the seller shall be as follows. Because it is a selling transaction, there is a cash inflow on T+1 and a cash outflow on T+64 and on T+246. In this form, the transaction resembles to an outright purchase/sale transaction.

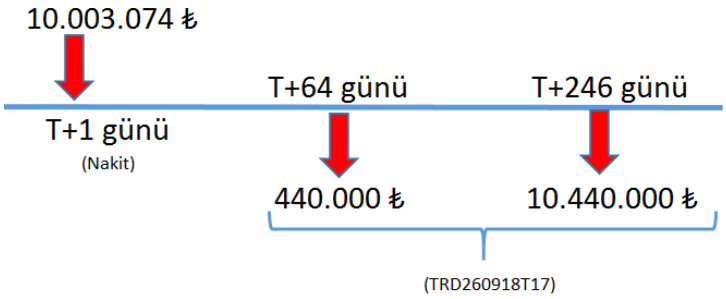


Figure 52 - Committed Transactions Market - Phase 2 Seller Cash Flow Example

Table 37 - Committed Transactions Market - Phase 2 Seller Risk Calculation Example

	Cash	Security	
Unstressed NPV	9.999.677 ₺	-10.068.252 ₺	
Stressed NPV	10.002.211 ₺	-10.698.748 ₺	
Initial Margin	-2.534 ₺	630.496 ₺	-627.961 ₺
Variation Margin	9.999.677 ₺	-10.068.252 ₺	-68.576 ₺
		Total Margin	-696.537 ₺

Because the cash amount of the transaction in the example on value date 2 is 10.003.074 TL, the net present value of this amount by 13.2% discount rate shall be 9.999.677 TL. The net present value of the security becomes 10.068.252 TL. And 68.576 TL difference between these two amounts makes up the variation margin.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of firstly the cash and then of the security cash flows are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of the cash flows must be taken into account. Considering the cash outflow in the future, the risk scenario is a decline in proceeds. When the risk scenario is applied, in other words, if the proceeds fall, the net present value of the cash increases to 10.002.211 TL and the net present value of the security increases to 10.698.748 TL. After performing these transactions, the initial margin is found as 627.961 TL.

Because the net present value of the security in this selling transaction is more than the net present value of the cash, the variation margin increases the total margin requirement. In that case, total margin requirement amounts to 696.537 TL.

7. CORRELATION BETWEEN DIFFERENT YIELD CURVES AND PORTFOLIO BASED MARGINING

Yield curves in the same currency but with different credit risks can have a relationship with each other. Curves based on government papers can be used as the base curve, and the other curves in the same currency can be obtained by applying a specific credit spread to the base curve. BISTECH applies the 3D window method in order to account for the different yield curves in the same currency.

For each principal component, BISTECH generates a prism (the window cube) in the wimdow sizes [PC1, PC2, PC3] space. This prism determines the maximum number of nodes that the two curves in the same window class may deviate from each other.

The 3D window method lists all vector cubes in the same window class next to each other.

- A result vector cube is created and placed next to the other vector cubes.
- A window cube is placed in every top node of the vector cubes.
- The result vector's value at node i is the sum of each vector cube's lowest net present value from the nodes inside the window cube that is placed at node i.
- The window cube slides down all nodes in the vector cubes and the value in the result vector cube will always be the sum of the lowest net present values from the nodes inside the window cubes.

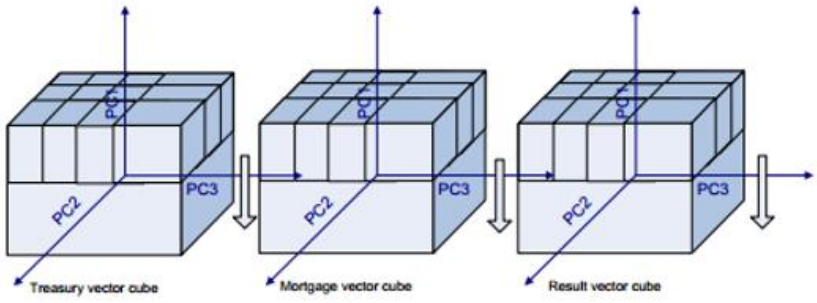


Figure 53 - 3D window method applied version on the vector cubes

The window tree is built up of several layers of window classes and the curves with the closest correlation are placed in the same window class in the bottom of the tree.

The window method is a recursive method; and it is first applied to the window classes in the bottom of the window tree. An application of the cash flow tables within the same window class on the vector cubes is illustrated below. During this process a new vector cube, the result vector cube, is created according to the procedures described above. The result vector cube is then combined with result vector cubes from the other window classes in the tree and, as a result, a new result vector cube is created. This procedure is repeated until the top of the window tree has been reached.

BISTECH can generate a cube in [PC1, PC2, PC3] space for each principal component and is able to define the degree of correlation between different yield curves. However, this order is parametric. PC2 and PC3 parameters in the risk calculations and in the examples given and explained in the previous sections are 0 and they have no effect on the risk calculation.

In the same vein, no correlation definition has been made between different yield curves, but a full correlation has been defined between the same yield curves due to the very nature of the CFM. The CCP service to be provided in the Debt Securities Market shall be launched based on these assumptions however, Takasbank shall be entitled to change it. The explained risk calculations and given examples in the previous section are expressed based on the assumption that there is only 1 security in the portfolio. In this assumption, the worst scenario of security in the portfolio constitutes the basis for the stressed NPV in the risk calculation. On the other hand, when many transactions with several and different directions are entered into an account, the system shall perform a portfolio-based calculation due to the functioning of the CFM model and the portfolio's yield curve-based worst case scenario shall imply the portfolio-based risk amount. Thus, the risk scenario identified for the portfolio to be created on the basis of a yield curve may not mean a risky situation for each security.

For instance, when buying and selling transactions are conducted on the securities associated to the same yield curve, an increase in interests for the buying transactions and a decrease in interests for the selling transactions shall constitute the risk scenario under normal conditions. However, since the CFM model applies a full correlation between the securities whose risk is calculated over the same yield curve, it must identify a risk scenario as an increase or decrease of the risks on a portfolio basis. Under these conditions, to which direction the volume size of the buying or selling contracts is, the risk scenario of that direction shall be dominant. In fact, the aim of the system is to be able to calculate the initial margin for the portfolio. Whichever scenario produces the highest initial margin, it shall apply that scenario and calculate the highest initial margin it can produce by the defined parameters. If both buying and selling transactions are conducted on the securities associated to different yield curves, a risk scenario shall be identified for each yield curve and the risk calculation shall be made based on such assumption.

Let's explain the situation in a more detailed manner by an example in which there are buying and selling transactions belonging to the same yield curve as well as those belonging to the different yield curves.

Illustrative Transaction: Let's assume that member A conducts the below-given transactions for the securities with T+1 on 23/01/2018.

Table 38 - Sample Portfolio

SECURITY	BUY/ SELL	AMOUNT	TRADE PRICE	SETTLEMENT PRICE	YIELD TYPE	COUPON RATE	REDEMPTION DATE	SETTLEMENT OBLIGATION / RECEIVABLE
TRT080818T12	A	12.000.000	12%	93,95	DISCOUNTED		08/08/2018	-11.273.550,91 ₺
TRT141118T19	S	10.000.000	98	99,67	FIXED	4,40	14/11/2018	9.966.813,19 ₺
TRFTHAL51811	S	11.000.000	11,75%	96,37	DISCOUNTED		21/05/2018	10.600.730,04 ₺
TRSTISB11918	A	9.000.000	11,5%	89,94	DISCOUNTED		14/01/2019	-8.094.622,07 ₺
								1.199.370,25 ₺

The collective version of the cash flows of the transactions shall be as follows.

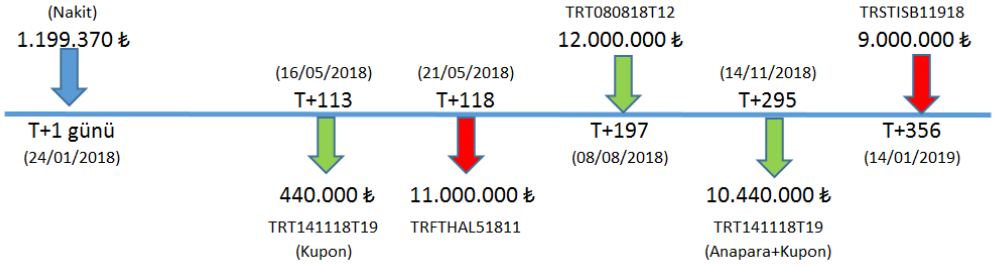


Figure 54 - Cash Flows of Sample Portfolio

As is seen, opposite transactions have been conducted on TRT080818T12 and TRT141118T19 instruments which are government domestic debt securities issued by the Undersecretariat of Treasury. The cash flows of these securities are shown with green arrows in the figure above.

There are also opposite positions on TRFTHAL51811 and TRSTISB11918 instruments which are Private Sector Bonds. The cash flows of these instruments are shown above with red arrows.

Table 39 - Portfolio Risk Calculation Example

	Cash	GDDS Security	PSDI Security	
Unstressed NPV	1.198.963 ₺	1.285.313 ₺	-2.522.182 ₺	
Stressed NPV	1.199.267 ₺	1.100.246 ₺	-2.879.943 ₺	
Initial Margin	-304 ₺	185.067 ₺	357.761 ₺	- 542.524 ₺
Variation Margin	1.198.963 ₺	1.285.313 ₺	-2.522.182 ₺	- 37.906 ₺
			Total Margin	- 580.431 ₺

Because the settlement price of the transactions with T+1 value date in the example is 1.199.370 TL, the net present value of that amount at 13.25% discount rate shall be 1.198.963 TL in inflow direction. The theoretical price of the securities in nature of GDDS is calculated as 1.285.313 TL in inflow direction. Whereas, since the theoretical price of PSDI securities is calculated as 2.522.182 TL in outflow direction, the netted-off difference of 37.906 TL is a variation margin that increases the total obligation.

In calculating the initial margin arising from the transaction, the stressed and unstressed net present values of the cash and of the securities are calculated and the difference between them is found. In designing the risk scenario of the transaction in the example, the direction of cash flows must be taken into account. Because the cash portion and GDDS security portion are components using the same yield curve, a risk scenario specific to these 2 portions shall be determined. When the rising and falling interest rate scenarios are applied to these portions, it shall be understood that the worst case scenario is the falling interest rate scenario. Because PSDI security portion uses a yield curve different from the previous two portions, we must address to the risk scenario separately for such portion. When the rising and falling interest rate scenarios are applied to PSDI security portion, it shall be understood that the worst case scenario is the rising interest rate scenario. Upon application of the risk scenarios separately for each portion, the net present value of the cash increases to 1.199.267 TL and the net present value of GDDS security decreases to 1.100.246 TL. And the net present value of PSDI security increases to 2.879.943 TL. After performing these transactions, the cash-based initial margin is 304 TL on credit, the GDDS security-based initial margin is 185.067 TL on risk, and the PSDI security-based initial margin is 357.761 TL on risk. Thus, the initial margin is found as 542.524 TL. In that case, total margin requirement accounts to 580,431 TL.

As is seen, the risk scenarios determined on a yield curve basis do not mean a bad scenario for each security. Although there is a buying transaction on TRT080818T12 security in the example above, in other words, despite to a cash flow in inflow direction, the falling interest rate scenario has been applied. Yet, in a portfolio just with a buying transaction of such security, the risk scenario would be a rise in interests. When, on the other hand, the cash portions of all transactions and the selling transaction of TRT141118T19 security are added to the cash flows and considered jointly, it shall be seen that the risk scenario is a fall in interests.

8. CONCLUSION

After the transition to BISTECH infrastructure in Borsa Istanbul Debt Securities Market (DSM), the risk and collateral services to be performed for such market shall be transferred to the body of Takasbank. The risk and collateral calculation methodology intended to be used in the Debt Securities Market is the Cash Flow Margining ("CFM") model designed for the fixed income financial products. Cash Flow Margining Model is based on a risk calculation over stress scenarios to be applied to the yield curves of fixed income securities being generated by various techniques. The stress scenarios are constructed by using the interest movements experienced in the past. In this sense, it is possible to define the Cash Flow Margining Model as a static replication of a dynamic RmD model.

The methodology of Cash Flow Margining risk management model is explained on the basis of each market and instrument and backed-up by the examples. As can be understood from the explanations and its name, this model is a system that basically takes the net present values of the cash flows in the portfolio as the base. The stress haircuts being regularly updated by Takasbank are applied to the designated cash flows and their stressed net present values are calculated. In the risk management, Takasbank intends to use only PC1 at the first stage. If other components are used in the subsequent stages, the parameter update shall be further announced.

The difference between the stressed and unstressed net present values makes up the initial margin. On the other hand, the difference between the trade price and the last price forms the variation margin. The sum of initial margin and variation margin generates the total margin requirement. The intention of Takasbank is not to receive variation margin for any instrument at the first stage but to receive variation margin for certain instruments as the process progresses. The risk management mechanism shall commence by full correlation parameters between the

securities related to the same yield curves and by zero correlation parameters for the securities related to the different yield curves. The risk scenarios determined on the basis of yield curves are applied to all cash flows associated with the relevant yield curve and the risk result is calculated based on this assumption.

In analyzing the risk amounts calculated according to the cash flow margining model, the issue requiring particular attention is that the securities made subject to the risk calculations must be addressed by grouping them on the basis of yield curves they are related to. A risk account of the member might include several types of assets whose risk is calculated over different yield curves. In such a case, the securities to be netted-off between each other through the buying and selling transactions shall be grouped on a yield curve basis and made subject to the risk calculation.

This conducted study is in nature that can be used to replicate the risk values calculated for the portfolios as well as in structure that can also be expanded to many applications within the scope of CCP service such as collateral management, margin call process, theoretical pricing process, default management, etc. for the Debt Securities Market

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