

Financial Derivatives & Risk Management
Professor J.P. Singh
Department of Management Studies
Indian Institute of Technology, Roorkee
Module 2: Introduction to Financial Markets and Instruments
Lecture 6: Futures Margining & MTM

How futures work?

Let us assume that an investor takes a long futures position sometime on day 0 ($t=0$) in an underlying asset S at the current futures price F_0 . Let the maturity of the futures be T days. Let the settlement price on the same day 0 be at F_0^* . Then, an amount equaling $F_0^* - F_0$ will be transferred to the investor's margin account as the mark to market settlement proceeds for day 0. Of course, this amount may be negative. It will be a credit if positive and debit if negative.

Let the settlement price on day 1 be F_1 . Again, in the course of MTM settlement for day 1, a further amount $F_1 - F_0^*$ will be transferred to the investor's margin account. This process continues on each day that the futures are traded in the exchange. On the $(T-1)^{\text{th}}$ day the transfer will be $(F_{T-1} - F_{T-2})$ and on the T^{th} day it will be $(F_T - F_{T-1})$. Hence the total transfers to the margin account over the entire life of the futures due to MTM will be
$$\sum_{t=1}^T (F_{t+1} - F_t) + (F_1 - F_0^*) + (F_0^* - F_0) = F_T - F_0 .$$

Now, because of arbitrage considerations, the spot and futures prices must converge on the date of maturity of the futures. Based on this, it is the practice in futures market to close the futures contract by marking the futures price at final settlement to the corresponding spot price on that date of the underlying. The final settlement of the futures contract is attained by setting $F_T = S_T$ and the difference $S_T - F_{T-1}$ constitutes the final settlement transfer to the margin account.

In view of this, the total transfers to the margin account become $S_T - F_0$.

Now, if the long party to the futures acquires the underlying asset in the market on the futures maturity date ($t=T$), he pays S_T . Thus, the net cost to this party for acquiring the underlying asset with the futures hedge is $(S_T - F_0) - S_T = -F_0$ which is precisely the forward price at which the party entered the futures position. Thus, the asset has costed exactly the price that a forward contract would have entailed if entered into at $t=0$.

The above explains what actually happens in the case of futures contract. How do the futures actually operate. How do they work as a forward contract notwithstanding the daily margin transfers and marking to market.

Margining system

The exchanges have different tiers of operators. We have the investor at the lowest rung. He enters trades through his broker. The broker either trades on his own behalf or through some clearing house member. The exchange interacts directly usually with its clearing house members. The exchange's clearing house performs all the settlement activities with its clearing house members.

A broker outfit may be a clearing house member on its own or may transact business through some other clearing house member.

Commensurate with this hierarchy, we also have different levels of margin requirements. We have the margin requirement at the investor, broker and finally the clearing members level which is to be posted by clearing house members with the clearing house.

So margin requirements at the investor level are to be met by the investor with his broker. Broker margin is to be maintained by the broker with his trading member or the clearing house member and the clearing house margin is to be posted by the clearing house member with the clearing house.

Investor margin

Investor margin comprises of two parts:

- (i) Initial margin; and
- (ii) Maintenance margin.

Initial margin

The initial margin is blocked by the broker in the investor's trading account when he enters into a futures trade. When a broker trades on behalf of an investor for a futures contract, the broker will require the investor to deposit funds in a margin account. The amount that must be deposited at the time the contract is entered into is known as the initial margin. The margin must be maintained so long as the investor retains a position in the futures. The investor is entitled to withdraw any balance in the margin account in excess of the initial margin.

The initial margin comprises of two parts viz (i) the span margin and (ii) the exposure margin. $\text{Initial Margin} = \text{SPAN Margin} + \text{Exposure Margin}$. Both the SPAN margin and exposure margin are prescribed by the exchange. The value of initial margin varies daily as it depends on the futures price. Initial Margin is usually a percentage of the contract value where the contract value is given by the product of the futures price per unit of underlying and the lot size. Thus, although lot size is fixed for a particular futures contract, the change in futures price implies that the initial margin will vary from day to day.

SPAN Margin is the minimum requisite margin blocked and 'Exposure Margin' is the margin blocked over and above the SPAN to cushion for any large MTM losses. Both SPAN and Exposure margin are specified by the exchange. The entire initial margin (SPAN + Exposure) is blocked by the broker, as per the mandate of the exchange.

SPAN margin

SPAN margin is the basic margin. SPAN margin is based on the concept of Value at Risk. It is set through an advanced algorithm called the "Standardized Portfolio Analysis of Risk" that calculates the SPAN margins on a daily basis. One of the key inputs that goes into this algorithm is the

'Volatility' of the stock. SPAN margin is calculated and updated 6 times in a day's trading at NSE.

Exposure margin

Exposure margin is an add-on margin on the SPAN margin to protect against some marking to market losses which may be unforeseen or which may be substantial. SPAN margin is the minimum level of margin that must be maintained at all times. Exposure margin, although it is also necessary but this margin is a more of a cushion against marked to market fluctuations. Exposure margin, which is an additional margin, to cushion for MTM losses varies between 3% - 5% of the contract value.

Maintenance margin

Initial margin is the margin that we deposit with our broker when we take up futures trades. Now with the passage of time, if we retain our futures position, NTN gains and losses will be transferred to our margin account on daily settlements by our broker. If we make profits on MTMs, our margin account gets credited and the balance increases and vice versa.

It may so happen that we have a long position in the futures and the prices go down, then debiting of losses to the margin will start eating into our margin account. The same will happen if we have a short position and the futures prices rise. Once the margin balance touches a threshold level (called maintenance margin) our broker will make a margin call on us asking us to deposit more funds in the margin account by the close of trading on the next day failing which the broker will close out our futures position. To ensure that the balance in the margin account never becomes negative a maintenance margin, is set.

If the balance in the margin account falls below the maintenance margin, the investor receives a margin call and is expected to top up the margin account to the initial margin level by the end of the next day. The extra funds deposited are known as a variation margin. If the investor does not provide the variation margin, the broker closes out the position.

It is reiterated that the minimum levels for initial and maintenance margins are set by the exchange. Individual brokers may require greater margins from their clients than those specified by the exchange. However, they cannot require lower margins than those specified by the exchange.

Margin levels are determined by the variability of the price of the underlying asset. The higher this variability, the higher the margin levels.

Maintenance margin is usually taken as the span margin. In other words, upto this span margin, the broker may allow an investor to trade but once his margin level goes below the span margin, the broker will make a margin call on the investor to deposit additional funds to raise the margin balance. Once a margin call is made, usually the margin has to be topped up to the initial margin.

It is not that the differential between the actual margin and the maintenance margin has to be topped up. General practice is that the margin has to be brought back up to the initial margin level. Now, this initial margin which comprises of the aggregate of span margin and exposure margin is dependent on the value of the contract. The value of the contract is the product of the lot size and the futures price. While the lot size remains constant, futures price changes.

Now, obviously if the investor is unable to honor the margin call which is made by the broker, the broker has no choice but to close out the position and the proceeds that arise on closing out are transferred to the margin account which is then closed.

These two procedures viz margining & MTM operating in tandem are essentially able to completely eliminate the risk of any default faced by the clearing house.

Marking to market curtails the loss to one day's fluctuations. Margining, which captures 99% one-day value at risk with additional exposure margin provide adequate additional cover for any possibility of default on MTM losses (one day's losses). Recall that 99% one-day value at risk is the SPAN margin. The exposure margin is in addition to that; it is over and above the SPAN margin. So these two margins acting together able to completely eliminate the possibility of default at the level of the investor.

Example

On May 8, you took a long position in one June IMM CHF contract at an opening price of \$0.6350. The initial margin was \$1,500 and the maintenance margin was \$1,200. The settlement prices for May 8,9,10 were \$0.6280, \$0.6355, \$0.6335. On May 11 you closed out the position at \$0.6365. Compute the cash flows on your account assuming that the opening balance was \$1,500 and there were no cash additions or withdrawals other than gains and losses from your futures position and any additional variation margin. The contract multiple is CHF 125,000 per contract.

Solution

On May 8, the investor took a long position in 1 June IMM CHF contract at an opening price of USD 0.6350. The initial margin that he deposited with his broker was USD 1,500, the maintenance margin is 1,200. That means if the margin falls below 1,200, the broker will give a margin call. So long as the margin balance remains between 1,200 and 1,500, it is still acceptable to the broker. And once the investor gets a margin call, he has to top it up to above 1500.

The settlement prices on the four dates are given and then the investor closes out the position at 0.6365. We are required to compute the cash flows and the balance in the margin account. The lot size is CHF 125,000 per contract.

Day	Trade Price (\$)	Settle Price (\$)	Daily Gain (\$)	Cumul. Gain (\$)	Margin Balance (\$)	Margin Call (\$)

1	0.6350				1500	
1		0.6280	-875	- 875	625	875
2		0.6355	937.50	62.50	2437.50	
.....		0.6335	-250	-187.50	2187.50	
6	0.6365		375	187.50	2562.5	

The investor enters into the trade at 0.6350 and he deposits a margin balance of 1,500. On the first day, that is on the day that he takes the futures position, the settlement price is 0.6280. This means a MTM loss of $USD\ 125,000 \times (0.6280 - 0.6350) = USD\ 875$.

This MTM loss of USD 875 will be debited to the margin account which will now have a balance of 625. This is below the maintenance margin of 1,200. Hence, a margin call will be made and the investor will need to top up the margin to the level of initial margin (USD 1,500). We assume that he deposits the necessary funds of USD 875 to bring up the margin balance to 1,500.

Next day's settlement price is 0.6355, thereby generating a profit of $125,000 \times (0.6355 - 0.6380) = 937.50$. This will be credited to the margin which will now show a balance of $1,500 + 937.50 = 2,437.50$.

Similarly, the next day's settlement yields a loss of USD 250 and the margin balance is 2,187.50. Finally, when the position is closed out the following day, the profit is 375. The margin balance now is 2,562.50 which will be transferred to the investor's account.

Reconciliation:	Opening balance in margin:	1,500
	Additional margin introduced:	875
	Cumulative profit on futures holding:	187.50
	Closing balance in margin:	2,562.50

Broker margin & clearing margin

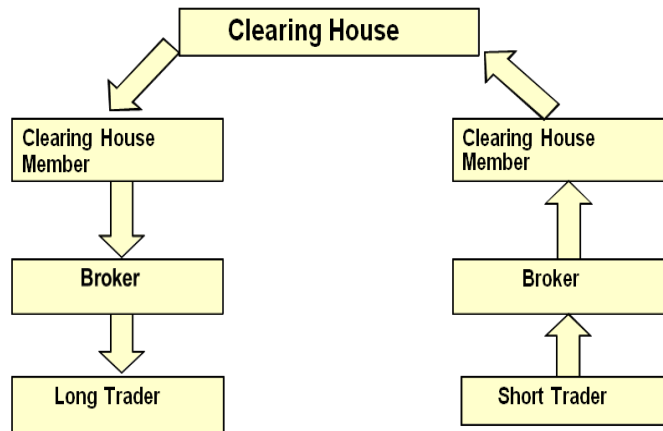
Just as an investor is required to maintain a margin account with a broker, the broker is required to maintain a margin account with a clearing house member (BROKER MARGIN) and the clearing house member is required to maintain a margin account with the clearing house (CLEARING MARGIN).

The margin accounts for clearing house members are adjusted for gains and losses at the end of each trading day in the same way as are the margin accounts of investors. However, in the case of the clearing house member, there is an original margin, but no maintenance margin. Every day the account balance for each contract must be maintained at an amount equal to the original margin times the number of contracts outstanding.

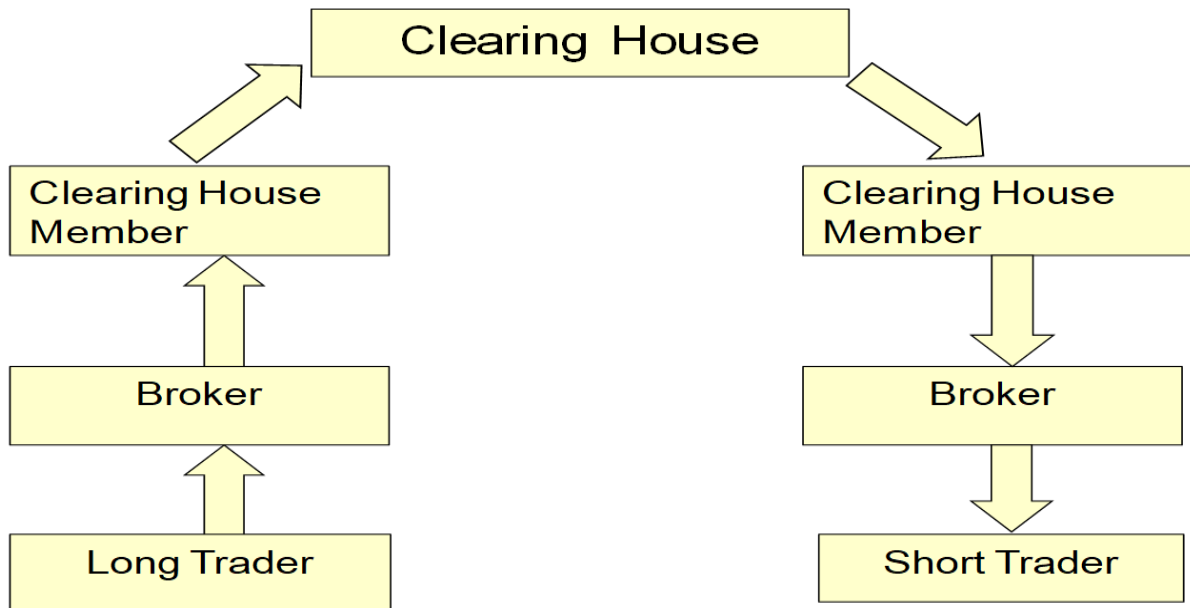
Thus, depending on transactions during the day and price movements, the clearing house member may have to add funds to its margin account at the end of the day, or before commencement of trading the next day. Or it may find it can remove funds from the account at this time.

Broker margin is at the level of the broker - the margin that the broker maintains with the clearing house member and clearing margin is what the clearing member maintains with the clearing house.

Margin cash flows when futures price increases



Margin cash flows when futures price decreases



This figurative representation explains the flow of funds consequent to a MTM settlement. Suppose an investor is a long trader in a futures contract and the futures price has increased. Then the long trader has, obviously, made a profit and the short trader has made a loss.

On MTM settlement, the MTM loss sustained by the short party is transferred from the short party's margin account to his broker who transfers it to the clearing house member with whom he (the broker) is maintaining a trading account. The clearing house, then transfers the amount to the clearing house member of the broker of the long party who transfers to the concerned broker, who finally transfers the amount to the long party's margin.

The reverse cycle operates when the long trader incurs a MTM loss, as shown in the second figure.

Implications of margining+marking to market

- (i) Default restricted to one-day price movements.
- (ii) Extreme cases of default covered by margins.
- (iii) Leverage.

So the implications of margining and marking to market are (i) default is restricted to one day's price movements; and (ii) extreme cases of default are covered by margins. Both these things together make it almost risk-free to trade in the futures market.

There is another important consequence of margining which is perceived to be the reason that derivatives have caused major financial debacles. That is the extensive leverage that these instruments provide.

Margining, leverage & risk

Let us assume that an investor has taken a long position in 100 units of a stock at $t=0$ at price S_0 per share. The investment is $100S_0$. Let this amount be borrowed by the investor @ $r\%$ p.a.

Let us assume that the price of stock rises by one unit to S_{0+1} at the end of one time period i.e. $t=1$. Then the investor's profit is $\pi(T)=100[(S_{0+1})-S_0]-r100S_0=100-100rS_0$.

Let us, now assume that the investor longs futures of maturity $t=1$ on the same stock with margin @10%. With the same investment i.e. $100S_0$, he can long 1,000 units of stock.

Given the spot price of S_0 , the no arbitrage futures price for maturity at $t=1$ would be $S_0e^r \approx S_0(1+r)$.

Thus, under the futures, given the stock price increase from S_0 at $t=0$ to S_{0+1} at $t=1$, the profit is:

$$\Pi(T)=1,000[S_{0+1}-S_0(1+r)]-100rS_0=1,000-1,100rS_0$$

Thus, $\Pi(T)-\pi(T)=900-1,000rS_0$. Since r would be of the order of 5-10%, $\Pi(T)-\pi(T)$ would be positive and quite large. Thus, for the same price change, an investor makes a much larger profit.

Now the issue is if this could be achieved always, why all investors do not adopt this leverage enhancing property of futures and make money out of it.

The reason is that we “assumed” a price increase from S_0 at $t=0$ to S_{0+1} at $t=1$ of the underlying. Now this increase is not a certainty. It is not invariably necessary that the underlying price will follow this pattern. It is not obligatory. It is not the only possible outcome for the underlying price. In actual fact, the price of the underlying evolves with a random component, it is a stochastic process. The future price is not precisely predictable. The underlying price at $t=1$ is a random variable. In fact, it is by no means certain that the underlying price at $t=1$ would be higher than S_0 . It can be lower than S_0 as well. And if it so happens that S_1 ends up lower than S_0 , then just as its profits were magnified by futures leverage, the losses would also be magnified. That is the implication of leverage. If the prices go up as assumed in the example, the profits get magnified, but the converse is equally true. If the prices go down, the losses also get accentuated.

Leverage operates both ways. And we cannot predict whether the underlying price is going to move favorably or otherwise. It is a random variable. It may increase or it may decrease, it is not predictable with precision.

The futures contract enhances leverage thereby magnifying the payoff many times without additional upfront investment. But the payoff that is magnified is itself unpredictable. That is why we say, that leverage in relation to derivatives has been attributed to massive financial debacles.

Example

Suppose that you enter into a short futures contract to sell July silver for USD 17.20 per ounce. The size of the contract is 5,000 ounces. The initial margin is \$4,000, and the maintenance margin is \$3,000. What change in the futures price will lead to a margin call?

Solution

Size of contract:	5,000 oz;	Futures price:	USD 17.20
Initial margin:	USD 4,000;	Maintenance margin:	USD 3,000

Thus, margin call will occur when USD 1,000 is wiped off from the margin. Since this is a SHORT position, the loss will occur when the futures price increases. Thus, price increase to induce a margin call $1,000/5,000=0.20$ i.e. a price of USD 17.40.

Now, the size of the contract is 5000 ounces. The futures price is USD 17.20, the initial margin is USD 4,000 and maintenance margin USD 1,000.

The position is short. A short position means that a loss arises on a price increase of the asset. Thus, a margin call would result from a price increase.

A margin call will occur when the margin falls from the initial margin of USD 4,000 to USD 3,000 i.e. when the margin is debited by USD 1,000 that is the investor suffers a loss of USD 1,000.

The investor will make a loss of USD 1,000 on a contract of 5,000 oz when the price changes by $1,000/5,000=USD 0.20$. Hence, the margin call will arise at a price of USD 17.40.

Example

A trader buys two July futures contracts on orange juice. Each contract is for the delivery of 15,000 pounds. The current futures price is USD 1.60 per pound, the initial margin is USD 6,000 per contract, and the maintenance margin is USD 4,500 per contract. What price change would lead to a margin call? Under what circumstances could \$3,000 be withdrawn from the margin account?

Solution

Size of contract:	15,000 lbs;	Futures price: USD 1.60
Initial margin:	USD 6,000;	Maintenance margin: USD 4,500

Thus, margin call will occur when USD 1,500 is wiped off from the margin. Since this is a LONG position, the loss will occur when the futures price decreases. Thus, price increase to induce a margin call $1,500/15,000=0.10$ i.e. a price of USD 1.50.

Example

At the end of one day a clearing house member is long 100 contracts, and the settlement price is \$50,000 per contract. The initial margin is \$2,000 per contract. On the following day the member becomes responsible for clearing an additional 20 long contracts, entered into at a price of \$51,000 per contract. The settlement price at the end of this day is \$50,200. How much does the member have to add to its margin account with the exchange clearing house?

Solution

Margin credited on original holding:	$100*(50,200-50,000) = 20,000$
Margin required on new contracts:	$20* 2,000=40,000$
Loss debited in margin on new contracts:	$20* (50,200-51,000)=16,000$
Additional net margin to be posted:	36,000

So there are three issues here: (i) the settlement price in respect of existing contracts has changed from 50,000 to 50,200; (ii) twenty more contracts have been created and each contract has a margin of 2,000; and (iii) these 20 contracts were created at 51,000 and these contracts are now at 50,200.

Original number of contracts were 100. The price has increased from 50,000 to 50,200 so an amount of $100*200=20,000$ is credited to margin as profit on these contracts. Since twenty new contracts were taken up, the initial margin on them of $20*2,000=40,000$ needs to be paid. Further, these twenty new contracts were longed at 51,000. The last settlement price is 50,000. Hence a loss of $20*800=16,000$ has been incurred on these new contracts due to MTM. Thus, the net amount payable to the margin is: $40,000+16,000-20,000=36,000$.